

**Growth and Expansion in Post-War Urban Design Strategies:
C. A. Doxiadis and the First Strategic Plan for
Riyadh Saudi Arabia (1968-1972)**

A Dissertation
Presented to
The Academic Faculty

by

Deborah Antoinette Middleton

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy in
Architecture

Georgia Institute of Technology
December 2009

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Deborah Antoinette Middleton

Approved by:

Richard Dagenhart, Advisor
College of Architecture
Georgia Institute of Technology

Dr. Gary A. Hack
School of Design
University of Pennsylvania

Dr. John Peponis
College of Architecture
Georgia Institute of Technology

Dr. Perry P. Yang
City and Regional Planning
Georgia Institute of Technology

Mr. Michael Dobbins
College of Architecture
Georgia Institute of Technology

ACKNOWLEDGEMENTS

I am most thankful to Allah, for guiding me with inspiration and courage throughout this dissertation and PhD process. I pray to Allah to grant me the patience and guide me in my future work to contribute to Saudi Arabian urban design and its history. Through the course of research and writing I have aimed to enrich the understanding of the urban design history of Riyadh for Saudi Arabian citizens so that they may continue to develop it for future generations as a beautiful Islamic family oriented city.

Riyadh, has benefited from the contribution and expertise of many great international and national planners, and their efforts would not have achieved their successes without the inspired leadership of its Governor, H.R.H. Prince Salman bin Abdul al-Aziz, who has expended all possible ways and means to benefit the city and its people. I am indebted to the kindness and encouragement of H.E. Dr. Mohammed al Al Sheikh as I endeavored to begin and complete this dissertation. The Arriyadh Development Authority Vice President Mr. Ibrahim al Sultan, Mr. Ahmed Assubail, and Mr. Ibrahiem Al Shaiyle and Dr. K. Sibert, all have shared their passion for Riyadh with me, welcoming me to the ADA with hospitality, generosity and encouragement as I undertook this research. Mr. Richard Bodeker was the first to introduce me to Saudi Arabia, and he has been most generous in providing me access to his archives and project files. His passion to create open green spaces and transform Riyadh into a beautiful Garden city will instill pride in all Saudi citizens for their capital city. I am indebted to early readers who kindly pointed out omissions to make this document stronger in its final form.

The College of Architecture at Georgia Tech has been generous in providing me opportunities to support my studies through the course of this PhD program by teaching design studios within the College. My advisor Richard Dagenhart has guided me through this project and I am deeply indebted to his patience. I am also sincerely grateful to Dr. John Peponis and Dr. Ronald Lewcock for their generosity, guidance and advice.

I am most grateful to the Constantinos A. Doxiadis Archives and Ms. Giota Pavlidou who has assisted me throughout my research with access to archival data and images for this dissertation. I am honored by Ms. Giota's dedication to my research and for her sincere friendship, and I am impressed by her knowledge of Doxiadis' life work. Unfortunately this dissertation is limited in its breadth to share the wealth of information that I have discovered.

There are no words to express my gratitude and love to my husband, Waqas Majeed for his love and encouragement.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	i
PREFACE	ii
LIST OF TABLES	iv
LIST OF ILLUSTRATIONS	v
ILLUSTRATION CREDITS	vii
LIST OF SYMBOLS AND ABBREVIATIONS	ix
SUMMARY	x
CHAPTERS:	
I. INTRODUCTION	
1.1 Constantinos A. Doxiadis	3
1.2 Ekistics for Human Settlements	6
1.3 Objectives of the Research	7
1.4 Research Question and Methodology	7
1.5 Thematic Structure of Dissertation	9
II. EXPANDING CITIES AND POST-WAR URBAN DESIGN STRATEGIES	
2.1 A Global Crisis of Rapid Urban Expansion 1950-1975	11
2.2 Post-War Urban Design Critiques and Debates	16
2.2.1 Garden City Strategies	16
2.2.2 Kenzo Tange and Tokyo Bay 1960	21
2.2.3 Candilis-Josic-Woods and Toulouse le Mirail 1967	24
2.2.4 Van Eestern and Lelystadt Holland 1959-1964	28
2.2.5 Van Der Broek and Bakema Pampus Plan Amsterdam 1964	31
2.2.6 Peter and Alison Smithson	36

TABLE OF CONTENTS

	Page
2.3 Post-War Urban Design Debates	37
2.4 Doxiadis Critique of Post-War Urban Design Approaches	39
 III. DOXIADIS AND THE THEORY OF EKISTICS FOR HUMAN SETTLEMENTS	
3.1 The Crisis of the Expanding City	43
3.2 Ekistics: The Science of Human Settlements	47
3.3 Settlement Analysis and Urban Design Strategies	48
3.4 The Model of Dynapolis	51
3.5 The Ekistic Community Class Hierarchy	55
3.6 The Modulus: A New Dimension for the City	58
3.7 Spatial Strategies for Ekistic Human Settlements	61
3.8 Doxiadis Associate Projects	65
 IV. THE FIRST MASTER PLAN FOR RIYADH, SAUDI ARABIA 1968-1972	
4.1 The Historical Context and Geography of Riyadh	75
4.2 Riyadh's Functional Importance as a New Capital City	79
4.2.1 Economic and Social Development	81
4.2.2 Transportation Development	83
4.2.3 Development of Saudi Arabia's Urban Planning Institutions	85
4.3 Doxiadis and the Commission for the First Strategic Master Plan for Riyadh	86
4.4 Existing Conditions 1968	89
4.5 The First Master Plan for Riyadh 1972	96
4.5.1 Strategic Organization of Territory: Macro-Structure	101
4.5.2 Action Area Connection Strategy	103
4.5.3 Transportation Structure	110
4.5.4 Strategic Organization of Territory: Local Structure	115
4.6 Saudi Arabian Influences on the Master Plan	122
4.7 Urban Expansion and Transformation Strategies	125
4.8 City and National Development Strategies	128

TABLE OF CONTENTS

	Page
V. RIYADH'S URBAN EXPANSION 1972-1996	
5.1 Revision of the Doxiadis Master Plan	133
5.2 Aerial Expansion of Riyadh	139
5.3 Population Growth	144
5.4 Implementation	149
5.5 Riyadh's New Urban Strategy MEDSTAR 1996-2021 & Revision 2030	157
5.6 Concepts of Urban Space and Modes of Urban Change	167
VI. CONCLUSION	173
VII. APPENDICES	
APPENDIX A: Breakdown of Land Use in the Proposed Riyadh Master Plan 1972, 1972 Master Plan for Riyadh Kingdom of Saudi Arabia, © Doxiadis Foundation Athens	182
APPENDIX B: Community Class Structure and Road Hierarchy 1972 Master Plan for Riyadh Kingdom of Saudi Arabia, © Doxiadis Foundation Athens	184
BIBLIOGRAPHY	

LIST OF TABLES

	Page
Table 1: Components of the Ekistics Community Class Hierarchy	56
Table 2: First Priority Areas for Detailed Design and Implementation, Doxiadis Associates, 1969	107
Table 3: Comparison of Urban Expansion by Extents and Population	143
Table 4: Estimated Growth of Riyadh's Population to 2000	146
Table 5: Comparative Matrix of Urban Design Strategies, 1972, 1978, 1996	168
Table 6: Comparative Matrix of Urban Planning Approaches	169

LIST OF ILLUSTRATIONS

Figure 1:	Tokyo Bay Japan, Kenzo Tange, 1960	22
Figure 2:	Plan of Tokyo Bay, Kenzo Tange, 1960	23
Figure 3:	Tokyo Bay Residential and Civic Axis Connections, Kenzo Tange	23
Figure 4:	Toulouse Le Mirail Transportation Structure Plan, Candilis-Josic-Woods	26
Figure 5:	Pedestrian and Traffic Networks Toulouse Le Mirail, 1967	27
Figure 6:	Lelystadt Netherlands Urban Design for Expansion, Van Eesteren 1964	29
Figure 7:	Neighborhood Spatial Composition, Van Eesteren 1964	30
Figure 8:	Built Areas of Buttenveldt: Spatial Planning	31
Figure 9:	Pampus Plan Amsterdam, Van Den Broek and Bakema, 1964	34
Figure 10:	Plan of Pampus Van Den Broek and Bakema, 1964	35
Figure 11:	Detail of Pampus Center Buildings	35
Figure 12:	Hauptstadt Berlin Concept Smithson's	36
Figure 13:	Pattern of Growth of Satellite Towns, C. A. Doxiadis	46
Figure 14:	Sequential Growth of Dynapolis, C. A. Doxiadis	53
Figure 15:	Synthesis of Residential Community Class V	60
Figure 16:	Design Strategy for a Static Change Resistant Modulus Unit	63
Figure 17:	Typical Sector Community Class V Islamabad Pakistan	67
Figure 18:	Master Plan Islamabad Pakistan	68
Figure 19:	Community Class V Layout Plan Saigon	70
Figure 20:	Saigon Master Plan Concept Alternative #3	71
Figure 21:	Conceptual Plan for Town Center Tema Ghana	72
Figure 22:	Map of the Kingdom of Saudi Arabia	76
Figure 23:	J. B. Philiby, Plan of Arriyadh, 1917	77
Figure 24:	Traditional Form of Riyadh Saudi Arabia	78

LIST OF ILLUSTRATIONS

Figure 25:	Al Malaz District, Arriyadh 1953	80
Figure 26:	1968 Urban Extents of Riyadh Showing Future Expansion	84
Figure 27:	Doxiadis Master Plan with Riyadh's 1968 Urban Extents Doxiadis Associates	98
Figure 28:	Alternative Urban Structural Strategies, Doxiadis Associates 1969	100
Figure 29:	Urban Structure of the First Strategic Master Plan Riyadh, 1972	102
Figure 30:	Road Connections Doxiadis Grid, Diplomatic Quarter and the 1968 City of Riyadh	104
Figure 31:	Transition Area Detail Design, Doxiadis Associates © Middleton 2008	105
Figure 32:	Detailed Design for Thahirah Dokhna 1972	106
Figure 33:	Organization of Territory by Community Classes, Doxiadis Associates, 1972	108
Figure 34:	First Master Plan Road Network Hierarchy, Doxiadis Associates, 1972	112
Figure 35:	Arial Photograph of the Central Axis Riyadh	113
Figure 36:	Typical Cross Section of Roads, Doxiadis Associates, 1972	114
Figure 37:	Riyadh Conceptual Model of a Community, Doxiadis Associates 1969	117
Figure 38:	Spatial Hierarchy Variations in 2 km x 2 km Modulus, Riyadh N13-N14-E01 N13-N14-E02 A1	118
Figure 39:	Doxiadis New Zoning Strategy for Action Area, Doxiadis Associates	120
Figure 40:	Meeting to Discuss the Preliminary Master Plan, Saudi Officials And C. A. Doxiadis in Athens July 28-Aug 4, 1969	123
Figure 41:	Stages of Development of Urban Areas Doxiadis Master Plan, 1972	127
Figure 42:	SCET 1978 Revisions	136
Figure 43:	SCET Action Area	138
Figure 44:	Doxiadis First Master Plan Overlay on Aerial Photo of Riyadh, 2001	143
Figure 45:	Population Growth Rates 1919-2000	148

LIST OF ILLUSTRATIONS

Figure 46:	Comparison Doxiadis Projections of Riyadh's Growth Rate and Actual	148
Figure 47:	1996 Traffic Volumes Overlaid on 1972 Master Plan Road Hierarchy	151
Figure 48:	Urban Open Space Study of King Faud Sector, 1986	153
Figure 49:	Aggregation of Small Blocks for Redevelopment of Modulus	155
Figure 50:	Photographs of Villa Housing in Riyadh	156
Figure 51:	Photograph of Duplex Housing in Riyadh	156
Figure 52:	Approved Subdivisions Since the 1980's in Riyadh	158
Figure 53:	Area Extents of the Metropolitan and Regional Area of Riyadh 2021 MEDSTAR	161
Figure 54:	The Arriyadh Metropolitan Structure Plan 2030 MEDSTAR 2009	162
Figure 55:	Photo of the Axial Spine of Riyadh 2008	163
Figure 56:	Proposed Revisions to Riyadh's Urban Limits	165
Figure 57:	Strategic Population Distribution Planning 2021 MEDSTAR	166
Figure 58:	Proposed Road Network 2002-2022	167

ILLUSTRATION CREDITS

Tokyo Bay Japan 1960, Kenzo Tange, © Japan Architect,

Tokyo Bay Residential and Civic Axis Connections, Kenzo Tange © Japan Architect,

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Plan of Pampus Van Den Boek and Bakema, 1964 Figure 9, 35, © NAI Archive

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Satellite Photo of Arriyadh, 2001 courtesy of the High Commission of Arriyadh Saudi Arabia

J. B. Philiby, Plan of Arriyadh, 1917, The Geographical Journal, March 1920, Vol V, No.

New Area Photographs, Riyadh by Doxiadis Associates 1968 © Doxiadis Foundation Athens

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Urban Open Space Study King Faud Sector, 1986 © Al But'hie, 1980

LIST OF SYMBOLS AND ABBREVIATIONS

Abbreviation	Meaning
ADA	Arriyadh Development Authority, High Commission
BBC	Building Better Cities Program
C.I.A.M	Congress Internationaux d' Architecture Moderne
MOMRA	Ministry of Municipal and Rural Affairs, Kingdom of Saudi Arabia
SCET	SCET/International/SEDES

SUMMARY

This dissertation resituates C. A. Doxiadis in Post-War urban design history with a detailed examination of how urban growth and change was addressed by urban design strategies as applied in the master plan for Riyadh Saudi Arabia, undertaken between 1968 and 1972. The Riyadh master plan commission is important within Doxiadis' career, occurring in the midst of his prolific writing projects and approximately eight years after he completed the Islamabad master plan, his most renowned project.

Most Post-War architects focused on the socio-spatial components of urban life, elaborating architectural projects that intertwined transportation, infrastructure, and concentrated on mass housing strategies. This dissertation argues that Doxiadis' contribution to urban design theory and practice during the Post-War period was to define a rational scientific methodology for urban design that would restructure settlements to enable urban expansion and change while addressing issues of community building, governance and processes of development. The applied urban design for Riyadh Saudi Arabia strongly exemplifies Doxiadis' rational strategy and methodology as outlined in Ekistics theory and the conceptual model of Dynapolis. The comparative analysis examines how Doxiadis applies the Dynapolis model in the urban spatial planning of Riyadh to organize urban territory at the macro and local urban scales, define neighborhood communities, and connect the new master plan to the existing spatial territory of the city. The longitudinal analysis contrasts the Doxiadis master plan, Riyadh's first urban development strategy, to the most recent comprehensive approach

MEDSTAR to understand how the Doxaidis' urban design has sustained its spatial continuity over time.

This dissertation makes two significant contributions. The first is to broaden knowledge of Post-War urban design specific to the spatial problem of urban expansion and change, and second to resituate Doxiadis within the Post-War history of urban design specifically revealing his previously unrecognized project of the Riyadh master plan undertaken from 1968-1972.

CHAPTER 1

INTRODUCTION

This dissertation resituates C. A. Doxiadis in Post-War urban design history with a detailed examination of his strategic master plan for Riyadh, the capital of the Kingdom of Saudi Arabia, undertaken between 1968 and 1972. The Riyadh strategic master plan commission is significant within Doxiadis' career, occurring in the midst of his prolific writing projects and approximately eight years after the completion of his more widely known project for Islamabad. The Riyadh master plan is a significant project and one of the last comprehensive planning commissions undertaken by Doxiadis prior to his death in 1975. The relative obscurity of the Riyadh project within the literature and history of urban design is due in part to Doxiadis' reluctance to publish details of the Riyadh Saudi Arabian commission within the DA Bulletin or Ekistics Journal.

In the immediate period after World War II, nations across Europe initiated reconstruction and rebuilding programs to repair the unprecedented damage from bombing campaigns. This urgent rebuilding campaign was partnered with aggressive economic strategies and comprehensive housing and new town building programs to address the severe housing shortage. During this period urban expansion became a significant issue demanding attention by urban designers and planners worldwide. The question posed in this thesis is how Post-War architects, specifically Doxiadis, addressed the problem of urban expansion and change within their design for the modern city.

The failure of C.I.A.M. to adjust to the new urban realities of the Post-War period stimulated architects such as Alison and Peter Smithson, the firms Candilis-Josic-Woods,

and Bakema and van Den Broek, Kenzo Tange and C. A. Doxiadis to reexamine the project for the reorganization of the city. Most Post-War architects focused on the socio-spatial components of urban life, elaborating architectural projects that intertwined transportation, infrastructure, and concentrated on mass housing strategies. The approach of Doxiadis in contrast aimed to develop a scientific methodology to assess the cities needs for its long term future and prescriptively apply design strategies to reorganize urban territory to enable unhindered dynamic growth and change. This thesis argues that Doxiadis' contribution to urban design theory and practice during the Post-War period was to define a rational methodology to urban design that would restructure settlements to enable urban expansion and change while addressing issues of community building, governance and processes of development. The applied urban design for Riyadh Saudi Arabia strongly exemplify Doxiadis' rational strategy and methodology as outlined in Ekistics theory and the conceptual model of Dynapolis. The analysis of design strategies examines how Doxiadis applies the Dynapolis model in the project of Riyadh to organize urban territory at the macro and local urban scales, define neighborhood communities, and connect the new master plan to the existing spatial territory of the city. The longitudinal analysis contrasts the Doxiadis master plan, Riyadh's first urban development strategy, to the most recent comprehensive metropolitan strategy MEDSTAR to understand how the Doxiadis' urban design has sustained its spatial continuity over time.

This dissertation makes two significant contributions. The first is to broaden knowledge of Post-War urban design specific to the spatial problem of urban expansion and change, and the second to resituate Doxiadis within the Post-War history of urban

design specifically revealing his previously unrecognized project of the Riyadh master plan undertaken from 1968-1972.

1.1 Constantinos A. Doxiadis (1913-1975)

C. A. Doxiadis (Doxiadis) was born in Greece in 1913. He received his first degree in architecture-engineering from the Athens Technical University in 1935 and a doctorate from Charlottenburg University in Berlin Germany in 1936. Doxiadis was appointed Chief Town Planning Officer for the Greater Athens area upon his return to Athens in 1936. Three years later he was promoted to the post of Department Head in Regional and Town Planning in the Ministry of Public Works (1940-1945). After the liberation of Greece in 1945, Doxiadis became Under Secretary, and then Director General of the Ministry of Housing (1945-48) a position central to Greek reconstruction efforts. He advanced rapidly to the positions of Minister-Coordinator of the Greek recovery program and top the post of Undersecretary of the Ministry of Coordination (1948-51).

Numerous influences combined to shape Doxiadis' approach to urban and regional planning and urban design. The Greek situation was even worse than the damages sustained by northern European nations. The war and occupation of Greece by the German Nazi's from 1939-1945 resulted in unprecedented destruction with a quarter of all buildings, towns and villages destroyed. The heavy damage sustained during the German occupation increased due to a civil war that continued until 1949. Progress in rebuilding the Greek infrastructure, its bridges and towns, persistently was set back as new developments were systematically destroyed. The loss of economic stability became the critical immediate concern for Greek Post-War policy which focused on restoring

stability and productivity to remote villages, and enabling comprehensive economic and infrastructure rebuilding.

Doxiadis' role as head of Regional and Town Planning in the Ministry of Public Works during and after World War II reflects his experience in balancing politically complex situations with strategic planning for Post-War reconstruction. From 1941 he systematically documented the scope of war destruction at a national scale. Following this research he published two booklets in Greece, *Ekistic Analysis* (1946) and *Ekistics Policy* (1947), which subsequently presented the aims of Greek Post-War reconstruction within a twenty year redevelopment plan framework. The American Marshall Plan enabled the rapid advance of Greek reconstruction plans to a five-year time frame beginning from 1948, ensuring Greece's reconstruction program essential completion by 1953 (Ekistics, 1977). These experiences led to the refinement of Doxiadis' theory of Ekistics for Human Settlements, which he had begun to develop during his doctoral studies as a program framework for international, national and regional development.

Doxiadis was a key participant in international reconstruction commissions in his role as the head of the Greek delegation to England, France and United States. He was involved as a key participant in the 1947 United Nations Conference on Housing, Planning and Reconstruction, and the 1949-50 Greco-Italian War Reparations Conferences (Kyrtis, 2006). Invitations to participate in United Nations (U.N.) Secretariat's sponsored conferences and meetings continued from 1947 to the mid 1970's, extending Doxiadis' influence and participation in shaping national and regional urban redevelopment and housing strategic policy. In 1964 he participated as a committee member of the U.N. Housing, Building and Planning program. In this capacity

he argued that the singular focus of policy on housing and regional science left the larger urban problems entirely uncoordinated, especially in the face of the incremental scaling of urban space which he viewed as an impending crisis of international proportions.

Global recognition and an influx of international invitations to undertake planning projects led Doxiadis to form Doxiadis Associates in 1953 as an international strategic planning consultancy firm, which capitalized on accomplishments and social networks previously established. Doxiadis Associates was one of the first global strategic planning firms, head quartered in Athens Greece, the firm operated worldwide with offices in over twelve countries. A review of Doxiadis Associates projects undertaken between 1955-1975 reveal numerous master plans and urban design strategies for national capitals such as Washington D.C. Islamabad, Baghdad, Greater Khartoum, Riyadh, and future extension schemes for Stockholm Sweden, and the Detroit region. In Nigeria, Doxaidis Associates designed twenty major urban centers and master plans for nine towns and sixty five villages in Libya, notably Masa el Brega and Beida were completed.

Doxiadis' world-wide design, planning and writing projects brought him acclaim and opportunities for intensive collaboration with future oriented contemporaries such as Margret Mead, Marshall McLuhan, in addition to many other important Post-War academics, economists and planners. The Delos Symposiums, organized by Doxiadis became a futurist oriented exploration to distill strategies for the emerging modern urbanism. The journal *Ekistics*, started by Doxiadis, fueled debates on the future city and established a platform for discussions on international urban and regional planning and design. Doxiadis' many contributions to urban design and planning were recognized by the Sir Patrick Abercrombie Prize, awarded during the VII Congress of the

International Union of Architects in September 1963. C. A. Doxiadis died in 1975 in Athens Greece.

1.2 Ekistics for Human Settlements

The problem of the rapid growth and expansion of the Post-War city is central to Doxiadis' Ekistics theory and his urban design and planning approach. The absence of comprehensive urban research for the Post-War period motivated Doxiadis to undertake an intensive study of urban problems associated with rapid and dynamic urban growth and change. Doxiadis outlined the numerous problems facing expanding cities in books such as: *Architecture in Transition* (1963), *Ekistics: An Introduction to the Science of Human Settlements* (1968); *The Two-headed Eagle: From the Past to the Future of Human Settlements* (1972); *The Concept of Ecumenopolis* written with Papaioannou, J. G. (1972) and *City for Human Development* (1972). Post-War urban conditions, in his view, were exacerbated by the rapid change in the basic dimension of settlements. He argued that the rate of change was the main causes of the loss of the urban spatial scales, which contributed to the loss of meaning and understanding of the function and values of the city. In addition, the physical pattern of most cities did not establish a separation of functions or address the problem of the increasing volume and dominance of automobiles over man. The increasingly overlap between village, town or city, and the loss of its natural environs were all aspects of the new urban crisis. Rather than limiting the design of the city to primarily accommodate mass housing schemes, Doxiadis focused on the spatial-economic possibilities of cities and their regions. He argued that enabling the growth of larger economies in cities would inform larger societal transformations.

The theory of *Ekistics of Human Settlements* as it became known was a prescriptive theory, emphasizing regional connections and the ability of the city to expand while ensuring the balance of forces between man, his environment, and technology.

1.3 Objectives of the Research

This thesis situates Doxiadis' design ideas and Ekistics theory within the larger context of Post-War urban design projects and establishes a longitudinal study exploring how these ideas informed the urban master plan for Riyadh, capital of Saudi Arabia. Importantly this dissertation examines how urban growth and change was addressed by many Post-War architects and resituates Doxiadis into Post-War urban design history. It is remarkable that Doxiadis has not been acknowledged in the recent academic research or urban design literature. Peter Hall's *Cities of Tomorrow: An Intellectual History of Urban Planning and Design in the Twentieth Century* (2002) makes no reference to the writings or projects of C. A. Doxiadis. Similarly Leonardo Benevolo's *History of Modern Architecture*, 1977 and Manfred Tafuri's 1976 critical *Modern Architecture 2/ History of World Architecture*, do not acknowledge Doxiadis' role in urban theory or urban design practice. Tafuri along with other urban design and planning historians, focus primary on the architectural projects of Bakema, Candilis-Josic-Woods, the Smithson, Team 10, and Kenzo Tange and their intellectual tensions with C.I.A.M. This dissertation argues that Doxiadis' role in establishing a new direction for Post-War urban design is significant and sharply contrasting with architects such as Bakema, Tange, Alison and Peter Smithson's, C. Van Eesteren and the firm Candilis-Josic-Woods.

1.4 Research Question and Methodology

The first question underlining this dissertation is how strategies enabling urban growth and change inform comprehensive urban master plans in the Post-War period. Specifically how did C. A. Doxiadis' theory of Ekistics with its focus on dynamic urban growth and change inform his urban design and development practice? What are the precise design strategies Doxiadis develops to enable urban growth and change as applied in the case of the first strategic urban master plan for Riyadh? The aim of this research work is to identity the strategic design and development approaches anticipating urban growth and change that he employed in urban design practice.

To answer these questions I critically examine first Doxiadis' theory of Ekistics, and second how his concept of the dynamic city generatively informed the first strategic urban master plan for Riyadh, undertaken by Doxiadis Associates (1968-1972). I first review the literature on Post-War urban development strategies to situate Doxiadis' urban design and development theory and practice in its time. Second I discuss the theory of Ekistics, drawing attention to the principle themes and methodologies which Doxiadis advocates to advance a comprehensive action-oriented urban design and development strategy. In answering the research question, I investigate how Ekistics theory and the model of Dynapolis inform the case of the first master plan for Riyadh. My analysis focus is on how urban design strategies for the macro and local neighborhood scales were established and how the master plan has maintained its spatial continuity and control of Riyadh's urban form throughout the process of ensuing expansion from 1972 – 2000.

The spatial strategies analyzed in this thesis were located in preliminary and final master plans, detailed drawings, meeting minutes, and project notes as prepared by

Doxiadis Associates in the course of developing the Riyadh project. Data for this research was obtained also through personal observations of Riyadh in the spring of 2006 when I visited this city upon the invitation of the Arriyadh Development Authority, and while I was living in Riyadh and was an Associate Professor with Prince Sultan University in the 2008/2009 academic year.

I am grateful for the encouragement and support of H.E. Dr. Mohammed al Al Sheikh, Vice President ADA Mr. Ibrahim al Sultan, Mr. Ahmed Subail, Dr. K. Sibert ADA, Mr. Ibrahiem Al Shaiyle and others area Directors within the ADA. The Arriyadh Development Authority graciously provided my accommodations, a driver and permission to explore and photograph the city as it is today. I am especially thankful to Mr. Richard Bodeker, (BW&P Abroad) for sharing his experience and insights into the urban transformation of the city and for numerous social introductions. Documents pertaining to the Doxiadis first master plan of Riyadh were located and reviewed in the Doxiadis Archive located in Athens in November 2005 and March 2008.

1.5 Thematic Structure of the Dissertation

Chapter Two examines how urban expansion and change was problematized and resolved in urban design strategies in the Post-War period. This chapter outlines the post war period dynamics informing urban policy formation specific to the problems of urban expansion. It also and provides a critical description of projects by the firm Candilis-Josic-Woods, van Eesteren, Tange, and Van Der Broek and Bakema undertaken in the Post-War period.

Chapter Three presents Doxiadis' Ekistic theory and outlines the elements of the model of Dynapolis.

Chapter Four establishes the historical background to the Riyadh commission undertaken by Doxiadis from 1968-1972 and outlines in detail the strategies employed in the Riyadh master plan to shape the rapid urban expansion the city to the year 2000 and meet the design charge of the project commission.

Chapter Five undertakes a longitudinal analysis and discusses how the continuity of the urban structure has been maintained through subsequent urban development and the city's rapid urban expansion. Riyadh's new metropolitan development strategy MEDSTAR is discussed.

Finally the case of Doxiadis' first master plan for Riyadh Saudi Arabia is presented as a significant project in the development of Post-War modern urban design history. The conclusion critically discusses the urban design strategies for the project of Riyadh and identifies Doxiadis' contributions to Post-War urban design as revealed by the analysis of this project.

CHAPTER 2

EXPANDING CITIES AND POST-WAR URBAN DESIGN STRATEGIES

The Post-War era was a time of rapid urban change. Reconstruction and urban expansion led architects and planners to deploy new design and planning strategies to address the failure of early 20th century design strategies and the increasing complex problems of urban life. This chapter reviews the urban design proposals by architects Cornelis van Eesteren, the firm Candilis-Josic-Woods, Alison and Peter Smithson, Kenzo Tange and the firm van Den Broek and Bakema, to ascertain how the problem of urban expansion and change was addressed in their design strategies. The chapter begins by highlighting the international problem of rapid urban expansion occurring in the Post-War period and critiques early century urban design approaches. The aim of this chapter is to provide background to situate Chapter Three and the inquiry into the urban theory and design strategies of Doxiadis.

2.1 A Global Crisis of Rapid Urban Expansion 1950-1975

The policy makers directing reconstruction efforts to rebuild cities and house displaced populations after World War II suddenly encountered a new problem of accommodating a rapid increase in population and spatial expansion of cities. Population forecasts of the 1930's inferred that most Western countries would soon experience a zero population increase with the possibility of eventual decline. By the late 1940's, changes in both fertility and population prospects were evident and population projections underwent continuous revision upwards by factors of 2 or more (Spengler, 1972). The urban situation was marked by severe housing shortages, dispersed

populations, and unprecedented migration of people between cities in Europe and world-wide. In 1956 the population division within the United Nations viewed a world-wide crisis to be underway, noting that an increase of the worlds' population was occurring far more rapidly than the growth of the preceding fifty year period 1900-1950.

Reconstruction strategies shifted in the early 1950's to address this accelerating problem of urban expansion and population growth. Concerns for growing slums and shantytowns were fore-ground in national and international debates, paralleled by deep unease for the stability of the social and physical fabric of urban life. The United Nations Secretariat's research on housing conditions and demographic development began to highlight the urgent problem of population increase, where the most dramatic example of accelerated urban growth was the emergence of shanty towns which appeared without warning and grew rapidly. The need for housing was further compound by perceived social problems relating to the unprecedented scale of population movement and migration. These factors highlighted the need for spatial policies to shape the development of urban inner cities, periphery and regions (U.N., 1960). The United Nations Secretariat in the report titled '*The World Housing Situation*' (1960) urgently stressed the need for nations to address housing conditions and new development. New policies were called for to improve housing standards, and establish fairly homogeneous climates and cultures for social, economic and physical stability.

The extent of the shortfall in housing requirements in major regions world-wide was startling. In African urban areas 7 million dwellings were recommended to be built between 1960 and 1975, with an additional 11 million dwellings for rural areas. In Latin America population growth averaged 2.4 percent per year in the decade 1950-1960. New

and existing urban slums and shanty towns were rapidly expanding, resulting in a 19 million dwelling unit shortfall. In Asia rates of annual urban population growth to vary between 5 and 7 percent, and estimates for an increase in housing stock in Asia was set at 11 million units for the period of 1960-1975. The total housing shortage in Europe was roughly estimated at about 14 million dwellings units between 1950 and 1960 of which 3.4 million units were in Western Europe. Accelerating urban population growth combined with slow economic progress further exacerbated already deteriorating housing conditions. The rapid emergence of shantytowns also began to raise urban community development concerns (U.N. 1962).

During the mid-1950's cities increasingly began to form the backbone of national planning agendas and urban and regional planning debates began to take center stage in as national productivity and service strategies began to explore regional population distribution. The creation of new towns persistently dominated policy agendas aiming to address housing shortages and redistribute metropolitan population growth potential. Community development was a critical concern as the turnover of residents and influx of migrants rapidly began to increase the mixture of races and cultures within communities. The overriding aim was to create a stable spatial and social environment propelled by a dominant view to rigidly control the rapid mixing of races, which was thought to destabilize the urban qualities that bind people together (U.N., 1963). Urban policies of this period reflect broad rationalist thinking confirming the need for a single self-consistent life world, where people could unambiguously place themselves in their social environment (U.N. 1963). The implicit presumption was that human life would be easier

if individuals did not have to manage heterogeneity of social worlds or modes of cultural understanding (Calhoun, 1995).

The pressing need for economic and social development strategies to be intertwined with the project of rebuilding cities began to dominate Post-War policy agenda'. An outline for comprehensive integration policies addressing economic and social development and the construction and redevelopment of existing cities was defined at the 2nd session of the United Nations Housing, Building and Planning Committee held in New York January 1964. The committee stressed that improvements in the housing and urban situation could not be achieved unless governments assumed direct responsibility for the formulation and execution of housing and urban development programs. The problem of population increase was of a magnitude that many considered beyond the competence of urban planning to solve (Wendt, 1962).

The planning solution frequently advocated was to control the development process of the settlement network through the rational distribution of population for a given area and specific period of time (Malisz, 1962). This policy agenda sought to imbed housing and urban development programs within national programs of economic development, so as to pressure coherence at both the national and international scales. The importance of cities to national and regional economic policies began to highlight the critical need to understand the processes and phases of urban growth.

Prior to World War II early research on the spatial character of growing cities focused on projecting urban population increases, and on establishing the spatial dynamics of city expansion. The first systematic study was by Adna Weber in her book *The Growth of Cities in the Nineteenth Century* (1899) delivered a statistical depiction of

the political and social causes and problems of urban growth and aggregation of urban populations. Weber's research was frequently considered in tandem with Charles H. Cooley's study on the location of cities, titled, *The Theory of Transportation* (Cooley, 1894) which studied the emergence and diffusion of transportation types and decentralization of urban areas. A new spatial theory by Park, Burgess and McKenzie referred to as the 'Ecological Theory of the City' in the book *The City* (1925) outlined the dynamic of urban expansion. Ernest Burgess's chapter titled, '*The Growth of the City; An Introduction to a Research Project*', established the general processes and spatial phases of urban expansion tendencies of a town or city. These processes were identified as extension, succession, and concentration, which were dominated by processes of expansion, metabolism, and mobility. Burgess's urban expansion model suggested the process of growth operates through the invasion of adjacent outer zones, a process referred to as succession limited only by the surrounding geography, natural features and historical factors of industry, railroads. In addition the processes of deterioration and regeneration were found by Burgess to explain how expansion disturbs the organic metabolism of the city when disorganization exceeds of organization. This early theory draws upon centralization, decentralization and mobility as measures of expansion and metabolism, and significantly influenced future urban research and design strategies.

Decentralization strategies began to dominate thinking across national, regional and urban planning ultimately fueling policies for the construction of new towns. In 1933 Walter Christaller's book titled *Die Zentralen Orte in Suddeutschlan* summarized *Central Place Theory* a spatial-geographical model for the city and its region. This theory explained the spatial growth and the location of settlements and their relationship

to aggregate economics. Christaller's theory of Central Places was influenced by optimum population theory, which began to exert strong influence on Post-War urban planning strategies aiming to manage urban expansion.

2.2 Post-War Urban Design Critiques and Debates

Two influential themes in urban design and planning followed the pre-war analysis of the expanding city by Burgess, Christaller, and others. The Garden City, an idea emerging from a critique of the 19th century industrial city by Ebenezer Howard, set out one strategy for urban expansion based on the establishment of neighborhood and community ideals which evolved into the concept of a uniform neighborhood spatial unit. The second approach by members of C.I.A.M., International Congress for Modern Architecture or *Congres Internationaux d' Architecture Moderne*, which was founded in 1928 in La Sarraz, Switzerland, aimed to define the functional city and a new urban design methodology according to modern principles.

2.2.1 Garden City Strategies

Decentralization and the formation of smaller settlements separated from the central city by green belts began to dominate design ideas after Ebenezer Howard's book *Garden Cities of Tomorrow* (1898) presented the idea of a model town as a strategy to accommodate urban expansion. Howard's *Garden Cities* design proposal dispersed population densities and incorporated industry, residences and social functions within a smaller scaled settlement that was separated from the central city by a green belt, and connected by public transportation. Multiple Garden Cities were to form based on an optimum road distance of a 20 minute circumference of movement, which equated to a 5

minute train trip from the larger city. Howards' Garden Cities strategy focused on the communal economics of new urban settlements, and their ability to generate new economic wealth and land values as well as accommodate the dispersal of populations from the central city (Hall, 1988). Garden City advocates working with the 'New Town' movement in England and the Regional Plan Association in the United States drew upon economic theories in their arguments supporting settlement decentralization and distributed formation of multiple smaller settlements.

In America the neighborhood unit became the central principle guiding the design for new settlements. Clarence Perry's idea of the neighborhood unit took hold in town design strategies. This new spatial unit was based on optimal population densities, pedestrian walking distances of ½ mile and the location of communal functions such as the local elementary school (Hall, 1988). The neighborhood center was to be located near a large open area or park, to encourage the development of community institutions. Clarence Stein and Henry Wright's urban plan for Radburn, a town with segregated arterial roads and surrounded by landscaped parks, advanced the model of the garden city from the perspective of traffic and pedestrian circulation (Hall, 1988). The idea of a parkway with limited access established the precedent of neighborhood units linked by civic parks.

In England, the *Garden City suburb* began to emerge as a variant of Howards' Garden City idea. Residential suburbs were surrounded by green open space and did not include industrial development. This condition required public transportation to enable workers to engage in employment with the larger city.

By 1912 the utopian planning ideas of decentralization advocated by Sir Raymond Unwin were demonstrated in his design for Letchworth and Hampstead Garden suburb. The need to accommodate larger populations and industry transformed the concept of the Garden City and Garden suburb into the *Satellite City*. The city of Wythenshawe envisioned to expand to the size of three Garden Cities, is one example of built outside of Manchester in the 1930's. The outcome of these strategies for large scale slum dispersals into the countryside began to amplify the problem of massive central city boundary extensions (Hall, 1988).

The need for a new rational architecture and city design approach began to dominate architectural thinking by 1932. The *Charter of Athens*, developed at the C.I.A.M. 1932 meeting, and finally published in 1947 as revised by Le Corbusier, became the defining document establishing new principles for the design of the future city and its architecture. The Athens Charter was a decisive response to the Garden City design strategies in both its proposal for self-contained communities and its scattering of dwellings and separation of inhabited areas. The C.I.A.M. design reaction configured the territory of the city according to modern architectural principles focusing on the separation of functions, the organization of a bounded site, the organization of traffic and legislation to resolve problems such as urban density (Geidon, 1965). Through the analysis of the city according to four functions; living, working recreation and transportation this modern design strategy demanded a highly ordered and concentrated city, which would accommodate urban expansion through increasing densities, high rise buildings and high speed traffic schemes. Bland urban districts emerged, functionally

organized as spatial units set within an open landscape dominated by high rise and high density residential living quarters.

After World War II the New Town movement became the largest single program of city building to emerge in England to address the growing population of larger cities (Bullock, 2002). The construction of new towns became the preferred solution to accommodate people displaced by slum clearance programs and redistribute populations from overcrowded neighborhoods and cities. Eight new towns were built around London between 1950 to the 1960's to accommodate a population of 400,000 and limit the expansion of the city by establishing an urbanized belt. Other slum clearance projects initiated green belt strategies to contain urban growth, which rapidly increased urban density and led to city re-zoning campaigns to develop high residential buildings. New town schemes did not integrate social and economic development resulting in the new residential areas offering no jobs. Governments widely acknowledged the criticisms of New Town Corporations to coordinate the processes and different phases of a new towns growth and development (Barnet, 1986, Girgouard, 1985).

Criticisms of New Towns began to place emphasis on community development represented by concerns for human associations, communication and everyday interactions. Disappointment with the limitations of the Athens Charter and the slow C.I.A.M approach to address Post-War urban problems motivated a group of architects considered to be the younger generation of C.I.A.M. to form *Team 10*. The Breakaway group, Team 10 included Peter and Alison Smithson, George Candilis, Jaap Bakema, Giancarlo de Carlo, Aldo Van Eyck, and Shadrach Wood amongst others. Team 10's critiqued C.I.A.M's ubiquitous technocratic approach to modern urban design, arguing

that its reliance on rigid spatial planning principles ignored the design of modern social places. Many modern built projects were criticized for their absence of social cohesion and naive belief that a community would emerge through the geographical isolation of functions and high density residential spaces. New concerns appeared; from orchestrating the organization of urban functions and operative dynamics of the city and its traffic; developing rich community life; and preventing the formation of urban shanty towns (Smithson, 1967, 1970). Team 10's emphasis was on human scale, social community and continuous change process, all of which were seen to be generated from within the structure of space and the social fabric. The street became the center of community life with human association and interaction becoming the essential quality of a functional community.

From the 1960's onward urban design proposals began to establish a clear separation of pedestrian and vehicular transportation, and present mass-housing schemes within an adaptable urban spatial structure. These urban design strategies sought to accommodate urban growth and change through the design at both the macro and local scales, and through a coordinated structure of transportation and territory. The accelerating rate of urban expansion began to raise a new problem of the spatial dimensions of cities. Problems relating to the location and scale of central functions began to expose problems with the overall purposeful organization of settlements and the distribution of housing and services (Llewelyn-Davies, 1966). This led to a fresh understanding of process and phases of urban growth and change. Studies of the projected life history of institutions in relations to their space needs and the overall organization of the emerging city began to be called for (Llewelyn-Davies, 1966).

The following section presents Post-War projects which aimed to define a new structure for the expanding city by architects Kenzo Tange, Van Eesteren and the firms Candilis-Josic-Woods, and van Den Broek and Bakema, and the Smithson's.

2.2.2 Kenzo Tange and Tokyo Bay 1960

Kenzo Tange and fellow Metabolist members, Kigonori, Kikutake, Masato Otaka, Fumihiko Maki, and Noriaki Kurokawa developed the conceptual plan for Tokyo Bay based on an organic reorganization of the city in 1960. The Tokyo Bay urban design proposal generated international excitement with its emphasizes on the need for urban planning to support processes of perpetual transformation and mobility, communication and movement. The aim of the design scheme was to redefine the urban structure from a radial centripetal system to a linear system that brought the city structure, the transportation system, and urban architecture into organic unity. The vision for Tokyo Bay as a new open spontaneous organization of contemporary society was in contrast to the state of confusion and paralysis found in the physical structure of the existing city, which was considered to be too old to cope with current rates of expansion (Tange, 1961).

The Tokyo Bay plan establishes a linear civic axis to redefine the city's orientation toward the bay. Important national and urban functions are relocated along the metropolitan center within the axial spine. The linear axis elongates with the process of urban expansion into a series of overlapping transportation loops linked together to form a graduated process of growth unit by unit. The main transport axis is lofted 40 meters above the city and 50 meters above Tokyo Bay envisioned as a suspended highway. A series of parallel highways connect perpendicular to this linear axis. A

system of secondary streets also extends out from the linear spine in parallel lines to locate residential areas in proximity to the civic axis. Urban spaces would develop and evolve in a clear and comprehensive way from the super structure to the local residential community.



Figure 1 Tokyo Bay Japan Kenzo Tange, 1960



Figure 2 Plan of Tokyo Bay Japan Kenzo Tange,1960

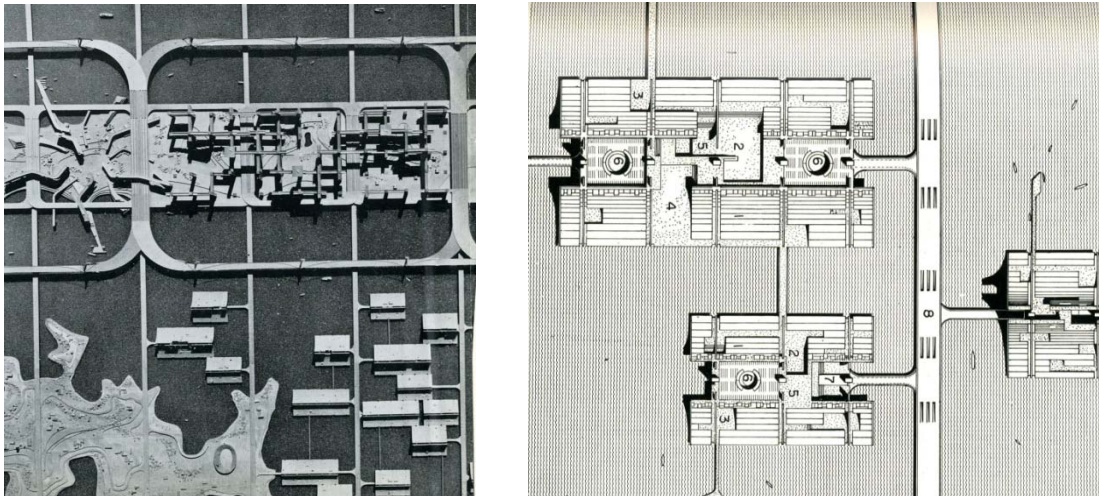


Figure 3 Tokyo Bay Residential and Civic Axis Connections, Kenzo Tange

A regular grid spaced system of *pilotis* and the *core structure* establishes the urban spatial framework, which joins the circulation arteries with buildings, uniting the two separate modular scales of the city and defines the layout of the city and its direction of expansion. The scheme orders the local spatial scale into functional units which connect to the structural framework. The spatial framework allows for a limited system of architecturally uniform residential housing aggregation with a modest potential for expansion defined by the range of the structural system. The Tokyo Bay plan aimed to generate new land values by moving out into the sea.

In contrast to the tradition of 'master plan', Tange and the Metabolists adopted an attitude where the city was engaging a dynamic process of ceaseless transformation. Tange's conception of change as process identified three phases the first was continual inner agitation (metabolic regeneration), the second was constant outward movement (growth), and the third was abrupt transformation (metamorphic change). Urban growth was embodied in ideas of evolution and organic extension which would naturally occur at different temporal rates for different scales. Eternal change was signified as transition, and processes of transformation which became embodied in the design of transportation and movement flows of the city. These natural conceptual processes were considered to reflect a biological evolution of society (Lin, 2006).

2.2.3 Candilis-Josic-Woods and Toulouse Le Mirail 1967

The urban design approach of Candilis-Josic-Woods aimed to simultaneously organize urban territory and synchronize spatial interactions between the urban center and its periphery (Avermaete, 2006). In contrast to C.I.A.M.'s design approach based on standards and the separation of urban functions, the Candilis-Josic-Woods strategy was to

redefine architecture and urban space based on the dynamics of everyday life. Human activities was the foundation of the 'Stem and Web' design concept to structure a town and its growth according to a system of spatial organization which was valid for every stage of growth and could be realized gradually (Woods, 1968). The street became the city's active center, establishing a network of collective functions, infrastructure that would support residential neighborhoods and dwellings. Topographical contours of the land defined the shape of the 'Stem', with the 'Web' defined by the design of a minimum structuring scheme which enables adaptation and change of architectural elements. The concept of Stem and Web is an open opposition to the popular approach of functionalist zoning plans, instead organizing functions according to human mobility in space (Avermaete, 2006).

Toulouse Le Mirail, a new city extension to the existing city of Toulouse was designed and realized in 1967, and is an example of the 'Stem and Web' urban design approach. The Toulouse Le Mirail plan structures the town's territory into two districts with main stems or deformed linear movement spines. A strong spatial hierarchy of transportation, pedestrian movement, and collective functions connects the macro and local spatial scales of the settlement and separates pedestrian and automobile traffic. Emphasis was placed on linearity, a form regard as open ended and negates the idea of a single center for the settlement. Mobility was no longer conceived of a measures of length, but of speed (measures of energy), and time (Lefaivre and Tzonis, 2006). All urban activities are situated in the linear street which is traffic free connected to a system of bent linear pedestrian paths bounded by green areas that traverse the district. Bounding the city is a nested structure of highways and local service roads terminating in

automobile parking areas which are located on the peripheral edge of residential districts supplemented by an internal network of streets which define the community boundaries of the settlement. The urban plan was to be implemented in stages to allow for modifications (Woods, 1968).

The plan reflects a layered web, a flexible network of pedestrian streets, open green spaces, and variously scaled functional spaces. The circulation system is characterized by a deformed and separate linear path structure of pedestrian movement which was overlaid with the similarly deformed linear road network.



Figure 4 Toulouse Le Mirail Transportation Structure Plan, Candilis-Josic-Woods, 1967



Figure 5 Pedestrian and Traffic Networks Toulouse Le Mirail, 1967

The transportation network establishes the settlements legibility but does not provide for a comprehension of the spatial organization of territory or the urban interior. A tight cluster of buildings is situated at the termination of the main pedestrian circulation path, limiting further expansion potential of the path network into the future. Generous open spaces are located within the organization of the spatial territory to accommodate the future development of residential areas and expansion of urban functions. The plan is restricted in its ability to expand beyond a defined limit.

2.2.4 Van Eesteren and Lelystadt Holland 1959-1964

Cornelis van Eesteren, the chairperson of C.I.A.M (1930-1947) declared that the functional organization of the settlement rather than housing was the driving force establishing settlement continuity. Urban chaos according to van Eesteren originated in the arbitrary placement of new and expanding functions in the existing plan of the city. The evolution of urban space did not exhibit unity due to the mixing of different historical times, spatial and material contradictions. Van Eesteren's contribution to modern planning was the articulation of a design process which stressed the gathering of information on functions, the definition of large scale structuring plan, and the realization of detailed local planning which would regulate zoning according to functions of housing, recreation, infrastructure, and work. The need for a rational and rigorous planning methodology was required to resolve the planning tension of designing for the separation of conflicting functions or the bundling of affiliated functions.

Van Eesteren's urban design strategy for the new town of Lelystadt (1959-1964) was based on the concept of 'Functional City'. This approach establishes a functional spatial framework for the city based on the statistical forecast of population growth. The urban design strategy is phased to accommodate urban growth by stages from 7,000; 17,000; 50,000; to ultimately 100,000 occupants. The civic center is centrally situated in the plan with multiple bounding edges such as roads; rail lines and open recreational green spaces, contain and define the urban territory. The scheme is geometrical with an intricate layered system of transportation within which functions are positioned. The plan sub-divides territory into four quadrants for future district development. Settlement growth follows a system of subdivision and aggregative expansion, a process of multi-folding of urban territory. The continuity of the urban structure is maintained with

increasing densification and by establishing an incremental expansion plan for both transportation and functions about a single city center core.



Figure 6 Lelystad Netherlands Urban Design for Expansion, Van Eesteren 1964

The main issues of modern urban life for van Eesteren were concerned with hygiene and the provision for recreation and leisure areas within the city. The detailed

planning of residential housing by type and quantity would shape the determination of urban densities, and the associated problems of layered infrastructure which focused on waterworks and transportation as critical elements of the polder city. The city no longer was a closed form, under conditions of settlement expansion urban design was to anticipate a process that fused city and countryside to maintain a sense of spatial continuity (van Eesteren, 1997). Van Eesteren's functional city was essential a rational structuring of housing, green and infrastructure.

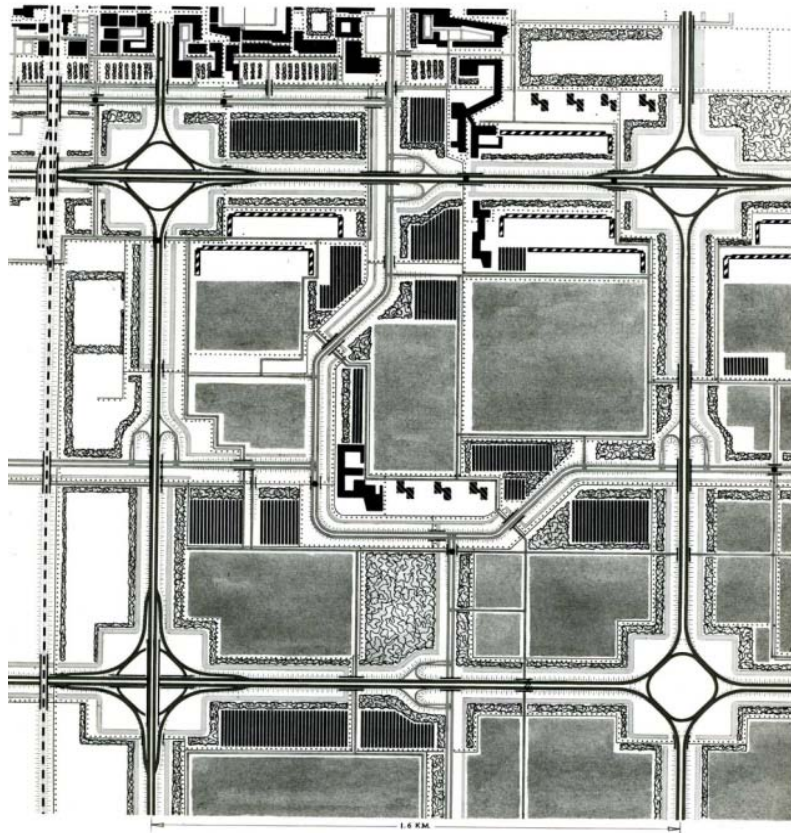


Figure 7 Neighborhood Spatial Composition Van Eesteren 1964



Figure 8 Built Areas of Buttenveldirt; Spatial Planning of Urban Functions Van Eesteren

2.2.5 Van den Broek and Bakema Pampus Plan Amsterdam 1964

In the Amsterdam Pampus Plan of 1964 the firm Bakema and Van Den Broek attempt to mediate the scale and density in new urban development. Their design enables fast and rapid access to existing urban districts of Amsterdam, while preserving the open space of the natural environment (Bakema, 1966). The design scheme aggressively appropriates the lake to accommodate the rapid expansion of Amsterdam over the water.. The shape of the proposed extension plan is partially determined by the shallow part of Lake IJ, the channels from the Amsterdam-Rhine Canal, the walking distance to the central arterial road (max. five min.) and a three kilometer range between district centers

and monorail stops. The design is characterized as a ribbon development along a linear transport spine and is similar to Kenzo Tange's Tokyo Bay proposal of 1960.

The Bakema and Van Den Broek urban plan establishes an interlocking bounded system of functions, built and open spaces arranged to optimize pedestrian distances. The plan combines the spatial organization of a linear city with distributed center nodes which creates the intensification of both urban density and function. The urban design is based on a system of graduated development within a predefined limit of urban expansion.

According to Bakema the residential groupings allow for the evolution of living and contain at their center interior spaces in which the schools, churches and shops are located. The units are bounded by open spaces containing recreation facilities and by natural countryside. The unit of design is no longer a single block but a clustered grouping or district of nearly 3000 dwellings and interwoven functions (Bakema, 1966) organized about the central transportation artery. Each district is composed of interlocking high density residential buildings set within an open recreational area. Three housing units accommodate 10,000 people, and form one self-contained urban unit. District densities varying from 30,000 to 200,000 people (Bakema, 1966). Multiple centers are situated at junctions of main arteries defined by high wall building structures located on a linear backbone. Three zones of twenty five distinctive residential neighborhoods compose the town with progressive population concentrations.

The extension is surrounded by 125 acres of recreation lands with the residential areas establishing a connection between city and country. Residential areas of limited size and high density are situated adjacent to the central spine enabling a direct

connection to the high speed transportation spine which contains eight traffic lanes and two secondary roads with six lanes, and integrated a high speed monorail creating a high speed traffic pipeline. Pedestrian crossings go over the central arterial road at a height of 4.50 meters where shops, public buildings and stops for the monorail are located. Residential areas are traffic free due to cul-de-sacs streets with parking garages situated underneath functional service areas such as schools, churches and business centers.

Bakema argued that the design of the Amsterdam extension combines country living and high density buildings, where building density and functional scale increase in accordance with population growth over time (Bakema, 1966). Figure 11 provides a details of *the Central Artery* (A) containing traffic, shops, offices and commercial business, *the Neighborhood* (B) the group of dwellings overlooking inner spaces in which schools, church, district hall and playgrounds with underground parking, *Outdoor spaces* (c), the open space between housing units containing field, tennis courts, allotment gardens, playing fields.

The problem of town and country planning is highlighted in this strategy as the natural bounding edges of the lake, assumed to form an urban limit, was challenged in the Bakema and van Den Broek urban design. Notably the existing urban condition of Amsterdam, which was defined by a star shaped pattern .is not reorganized nor restructured by the design proposal. The design strategy also does not address future transportation needs but rather its focus was on establishing a connection between the city and its region.

Bakema's strategy for urban growth was to establish an urban framework which allows individual additions and alterations (Bakema, 1966). Jaap Bakema was a member

of both C.I.A.M and Team 10 and argued that people inject life into their urban environment, which was the means by which to create variety and individuality into an anonymous city.

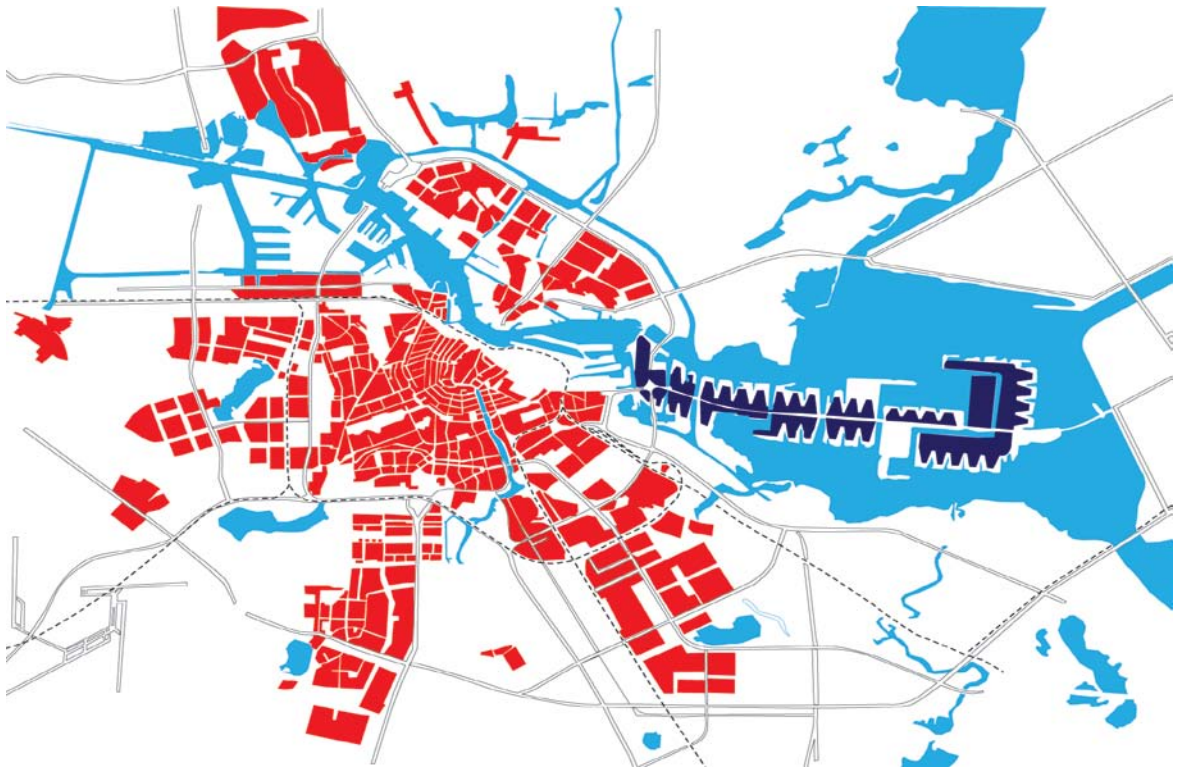
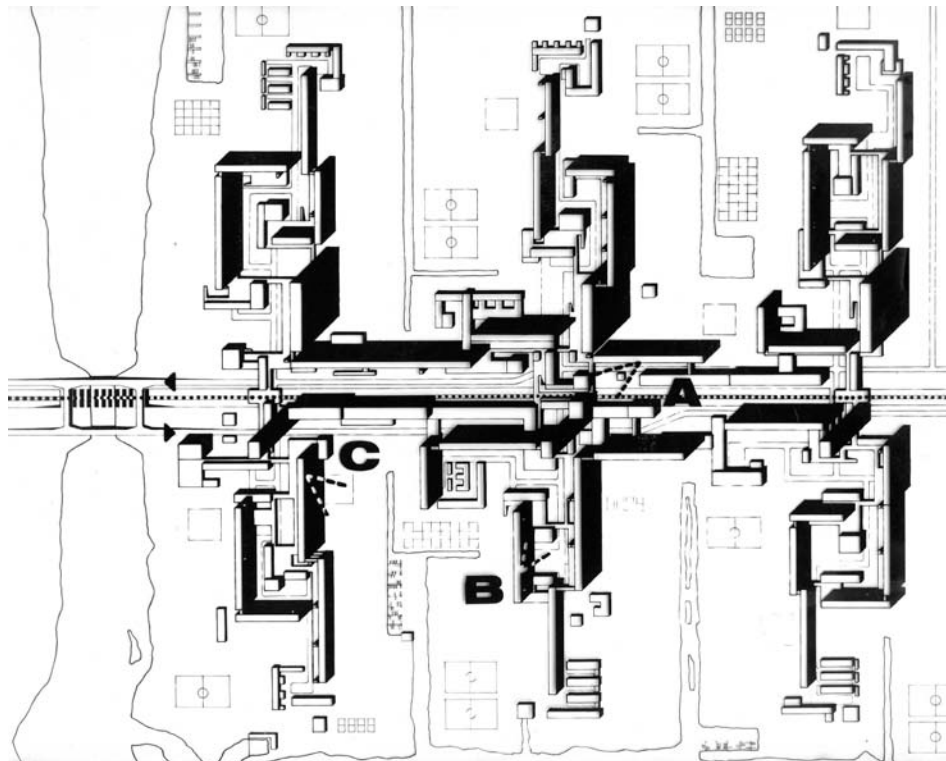
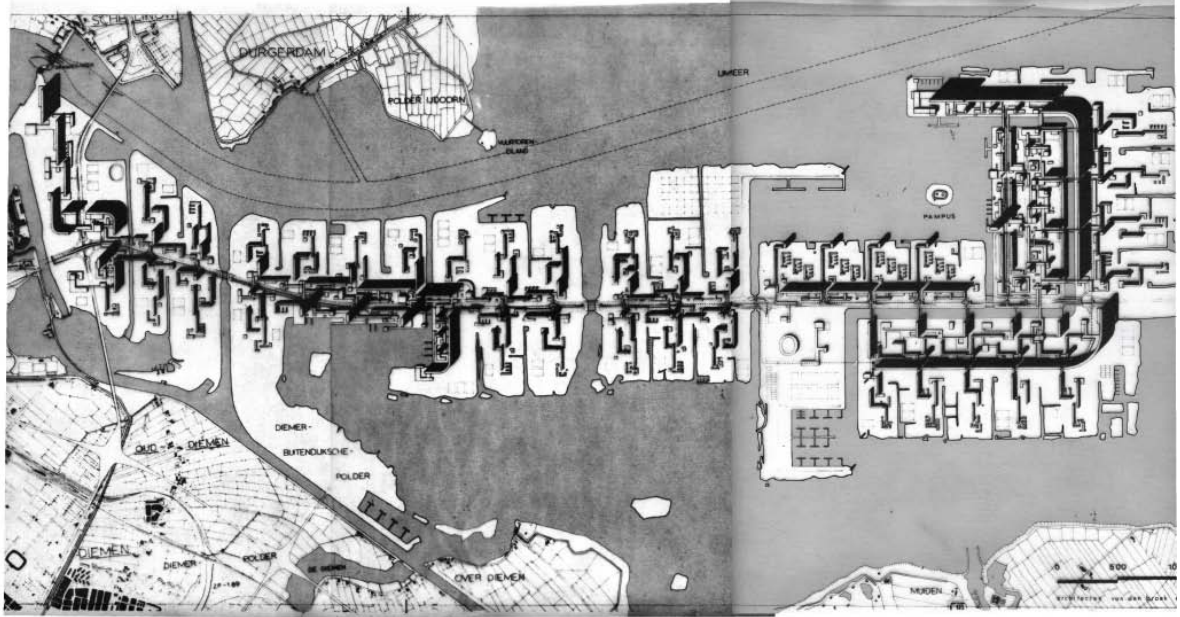


Figure 9 Pampus Plan Amsterdam, Van Den Broek and Bakema, 1964



2.2.6 Peter and Alison Smithson

Peter and Alison Smithson stressed the need for consistency and unity as the defining element for an expanding city. The Smithson's considered the central flaw of municipal town planning to be its fundamental structuring of urban life patterns in advance of circumstances. Rather they envisioned the city as a free-system mutating to the complexity of human relations where the local spatial form of the city would plastically adapt in response to the organization of the whole complex. As the complex changes with the addition of new parts, so the scale of the parts must change so that they and the whole remain in dynamic response to each other (Smithson, 1967). The transportation system, the city's most permanent urban structure, establishes the Smithson's design logic and principle strategic element.

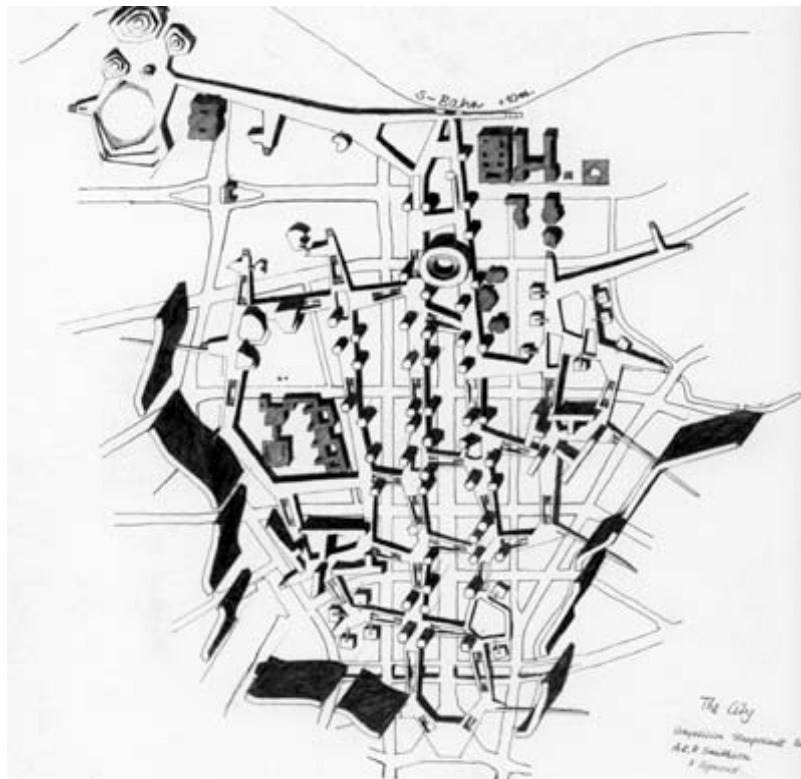


Figure 12 Hauptstadt Berlin Concept Smithson (c) NAI

The Smithson's proposal for the London Roads Study (1962-63) focused on the integration of transport infrastructure into the existing city fabric. Functional classes of services, commercial, administrative and recreation areas were formulated as parallel structures sometimes coinciding with combined traffic arteries, and sometimes running parallel with them (Risselada, Van Den Heuvel, 2006). Their best known project is the 1958 competition entry for East Berlin. This project imposed modern towers and elevated highways over the city's historic core, detaching the future city from its present and past. The plan's structural framework was articulated by multiple singular transportation systems. Criticisms of the Smithson's scheme focused on the separation of multiple circulation paths which overwhelmed the organization of territory and established a prefabricated uniformity that was ultimately lifeless and alienating.

The Smithson's argued that cities must have a moral character, established by the application of design principles based on optimum scale and functional composition (P. Smithson, 1964). The desire to create sameness where change occurred simultaneously throughout the system was a dominant theme in their projects. This strategy resonates with the period policies for maintaining stable communities in the face of high migration, cultural difference and rapid change. Peter Smithson considered the scale of projects such as Tokyo Bay to be corrupting, distorting the development of social communal values by emphasizing large scale property development.

2.3 Post-War Urban Design Debates

Richard Llewelyn-Davies suggested that the late 1960's urgency of addressing urban growth and change had only very recently begun to be understood or accepted.

“Until almost up to the present time it has been assumed that there is a basic size for a town or a community and that one of the tasks of planning is to limit or contain the town or community to that size. If plans are to be open-ended, and hold the capacity to absorb growth and change with the minimum of destructive stresses arising from that growth and change, many traditional concepts have to be re-examined and a theoretical understanding of the on-going pattern of growth and change in our cities needs to be constructed.” (Llewelyn-Davies, 1967).

Three broad approaches to deal with the expansion of central functions were outlined by Llewelyn-Davies. The first was to plan a great deal of empty space around all urban functions at the start, second to leap-frog the institutions, which required this space from the centre into more peripheral positions over a period of time; the thirdly to have some system of colonizing so that an expanding building such as a university can take over and occupy the existing surrounding buildings. Llewelyn-Davies viewed the urban functions and institutions as determining the settlements form and patterns of life and growth (Llewelyn-Davies, 1966).

Post-War architects criticized the new cities designed according to the Garden City and the Charter of Athens, as forming alienating environments that did not establish social communities, or support the increasing needs of communication and mobility. Regional strategies in the period of 1940-1970 increasingly abstracted zoning programs, movement flows and growth scenario development. The structural backbone of the regional city plan was the network of existing and projected roads, viewed in tandem with municipal extension plans. The city and increasingly its regional environs were being conceptually reframed by design strategies aiming to structure the regional city and its territory. Design strategies were dominated by the formation of new satellite cities, optimum neighborhood designs and approaches advocating the linear extension of existing urban forms.

The transportation system became the design device which organized territory and the physical infra-structure of electrical and water works. Planning schemes increasingly exhibited a clear structure of freeways and secondary arterial streets, points of interchange and termini for vehicles. Infra-structures capable of guaranteeing the development of the city by stages was further emphasized through the clear bounding of the periphery edge of the settlement, either at the macro scale or local scale. It was clear that transportation networks and road system set the pattern of spatial relationships and exerts powerful controlling influences over every facet of a city's development (Llewelyn-Davies, 1967). Louis Khan, in his 1953 essay, 'Towards a Plan for Philadelphia', placed emphasis on the street as center for a hierarchy of movement flows establish architectural order and convenience over speed. In Khan's plan for Philadelphia, the system of mobility dominates over volumetric descriptions of buildings and outdoor spaces of the city (Lefaivre and Tzonis, 2006). The idea of a highly compact commercial center with strict separation of pedestrian and vehicle traffic also became embraced as a planning ideal for the Smithson, van Der Broek and Bakema, and van Eestern.

2.4 Doxiadis' Critique of Post-War Urban Design Approaches

Doxaidis argued against the urban utopia emerging in the Post-War period which he considered to be a strategic reversal from the modernist agenda of C.I.A.M. and its new urban design elaborations (Doxiadis, 1968). The Post-War urban design strategies of architects such as van Der Broek and Bakema, Candilis-Josic-Woods, and the Smithson's were short term design schemes primarily focused on accommodating at most five and ten years of urban expansion.

Compact cities, decentralization and dispersion of a dense city with satellite settlements were for Doxiadis dangerous solutions that did not address the organization of urban functions, the needs of the region, nor the spatial expansion needs of the central city. Over time urban growth of the city center would incorporate satellite developments into its main body, connecting to form an expanding metropolis of interconnected cities (Doxiadis, 1968). He argued that a regional design strategy was needed that would direct the future development of cities beyond its immediate scale. Bakema and van Der Broek's urban design for Amsterdam also did not provide a solution to guide Amsterdam's growth in the long term. The Pampus plan spatially responds to the existing urban form of Amsterdam and avoids the analysis of the existing dynamics of the city's life patterns. Similarly Candilis-Josic-Woods Toulouse Le Mirail plan avoids addressing the longer term spatial problems of urban growth. Their utopian design strategy establishes a separate satellite city connected by high speed highways to the city of Toulouse. The strategic approach adopted by Van Eesteren to accommodate population growth by increasing densification of the compact city center over time was a strategy that Doxiadis viewed to be at the crux of urban transportation problems.

According to Doxiadis a new type of settlement, a multi-nucleated city, was emerging that was in contrast to cities of the past that were a single nucleus settlement. The change in spatial scale and population size of a settlement, and the mis-alignment of functions was resulting in the inability of the city to support service growth. The lack of an integrated planning model within New Town schemes highlighted the need for a comprehensive analysis of processes related to the daily needs and function of

settlements. The solution required the reforming of the city according to a system of spatial scales that created a unified framework of development for the future.

Chapter Summary

Post-War urban policy focused on the prevention of slums and shanty towns, controlling the settlement patterns of urban migrants and structuring the flows of people and the economy. Social problems associated with the change and transformation of the social fabric of the city began to emphasize the need for sameness and solidarity of communities. The implicit presumption underlying Post-War urban design approaches was that human life would be easier if individuals did not have to manage heterogeneity of their social world or modes of cultural understanding (Calhoun, 1995). The vision was to establish a single self-consistent life world where people would inhabit the city unambiguously to easily place themselves in their social environment. This concept invoking ideals of normality and sameness influenced utopian ideals specific to how social life ought to be ultimately organized. The aim of Post-War housing policy was to improve housing standards, and establish fairly homogeneous community climates and cultures. Establishing a single structural system for the city enabling it to be perpetually comprehensive with the ability to enable equal accessibility to all spatial parts became a key facet of urban design strategies. At the local scale urban design strategies focused on establishing an optimal neighborhood configuration which separated pedestrian and automobile traffic and create connectivity across the district.

The uncertain and inaccurate science of population projections further resonated with the need for an urban structure which embodied concepts of flexibility to enable

contraction or expansion and the insertion of new and expanding functions and services. The increase in spatial scale of functions and expanding range of movement challenged the previous held beliefs specific to the location for services and functions within the city and its region. The operative dynamics of spatial growth and transformation of the city and region began to infuse a sense of impermanence and uncertainty within design strategies.

CHAPTER 3

DOXIADIS AND THE THEORY OF EKISTICS FOR HUMAN SETTLEMENTS

Doxiadis argued against the urban utopia's emerging in the Post-War period, stating that these were strategic reversals from the modernist agenda of C.I.A.M., which had sought to redefine the city through a new synthesis and elaboration of urban design models (Doxiadis, 1968). Instead he stressed the need for a new urban design approach that would accommodate the long term planning needs, functional organization and dynamic expansion of a city. Doxiadis' urban design theory of Ekistics and the model of Dynapolis aimed to reform the C.I.A.M. rationalist design model. This chapter presents an overview of Doxiadis' perspective on the crisis of urban expansion and discusses the Ekistics approach he advocated to advance a new structure for the city to accommodate urban growth and change.

3.1 The Crisis of the Expanding City

Doxiadis believed that urban design and planning must consider cities and their regions as vehicles to enable the growth of larger economies, which would arouse larger societal transformations. The real dimensions and significance of the urban expansion problem had not received yet the recognition it deserved. Conditions continued to deteriorate under the impacts of accelerated urbanization and intensive demographic pressures on the heavily congested urban and metropolitan centers (Doxiadis, 1964). The crisis of the rapidly expanding city was outlined by Doxiadis within the Ekistics Journal and his published writings, notably *Architecture in Transition*, (1963); *Ekistics: An*

Introduction to the Science of Human Settlements (1968); *The Two-headed Eagle: From the Past to the Future of Human Settlements* (1972); and *The Concept of Ecumenopolis* (1972), written with Papaioannou, J. G..

The most common conception of the problems was one of unsatisfactory housing conditions in some parts of the world. Rapid urban expansion was increasing as population growth and expanding economies combined and the existing historic core of a town was at the center of the process of economic expansion. Variable rates and scales of expansion and spatial transformation were resulting in uneven development and disorganization of the settlement and contributing to the destruction of the original city center. As population increases the demand of urban functions amplify resulting in the expansion of service centers, commercial areas, and the need for new functional elements to meet the increasing service demands of the city. In Doxiadis' estimation urban settlements no longer could function properly and assume an appropriate shape and form.

The continuous growth of the spatial scale of the settlement was resulting in the continuous fragmentation of the whole into administrative units which were becoming completely independent from each other (Doxiadis, 1963). The automobile was increasing the range of movement and acceleration the pacing of urban life resulting in the displacement of the pedestrian scale of the city. The unending construction of road networks to support increasing traffic volumes was one cause of the urban imbalance which was generating the multi-speed settlement. Spatial scales between automobile and pedestrian were also blurring due to the increasing range of individual kinetic fields of movement and the increasing dominance of the automobile in all facets of urban life. The unprecedented increase of population; the tremendous rate of urbanization; unforeseen

and non-systematic technological progress; and the huge increase in the average per capita income were all causes of the crisis.

Doxiadis' critique also targeted the short term predictions of an urban future of only five or ten years by Team 10, C.I.A.M members and others. But the central problem with most existing settlements was that they only allowed for a limited degree of urban growth due to the inherent restrictions of their spatial structure. Confusion over urban density resulted in the over expansion of the city as too many satellites suburbs were created around the city to establish lower densities. Doxiadis considered that satellites as a detached settlement form do not integrate into the expanding and dynamic settlement. Instead of relieving the central city from pressures, they increase these pressures as the central city continuously expands over time and absorbs these temporary satellite settlements.

Doxiadis' prescriptive approach based on Ekistics aimed to coordinate the fields of economics, social sciences, political and administrative sciences, technology and aesthetics into a coherent whole, leading to the creation of a new type of human habitat. He emphasized the dynamic city as the essential paradigm that must replace conceptual contrasts such as the condensed and spread-out city, or the garden city and the cement city, or the contrast of city and country. The constant acceleration of economic growth processes and influx of people and automobiles was creating a new type of settlement, the dynamically expanding settlement, which Doxiadis referred to as Dyranapolis.

“We are witnessing an unprecedented growth of population, an unprecedented influx of population into urban areas, which is leading to a much greater growth of their population than in the past, an unprecedented mechanization of the means of transportation which means an explosion of our cities into space and furthermore, a change in social structure, a change in economy, a change in technology. Because of all of these reasons the urban settlements of the present are changing at a rate that is

so fast, that on many occasions humanity has not been able to understand that we have entered into a new era, into the era of dynamically growing settlements.”

C. A. Doxiadis, 1963

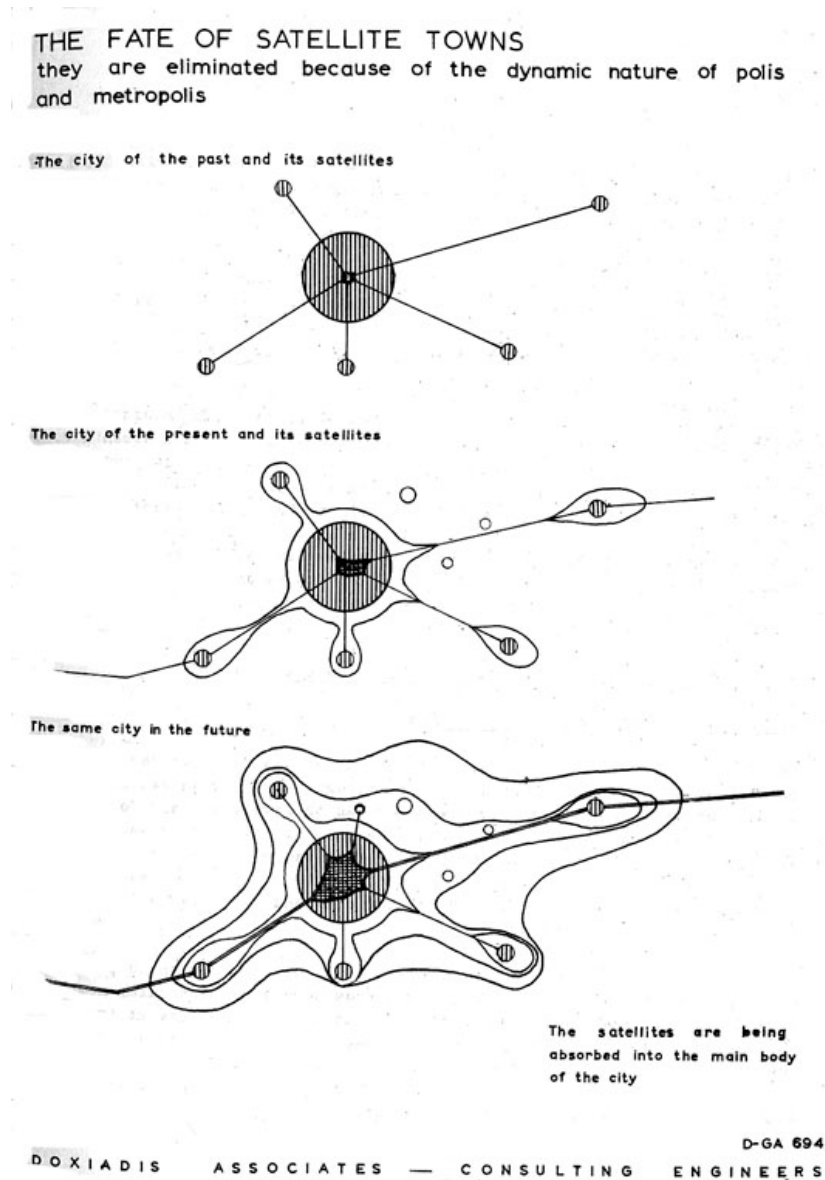


Figure 13 Patterns of Growth of Satellite Towns, C. A. Doxiadis

“The solution lies in reorienting the existing settlements spatial structure to accommodate the formation of multiple scales and speeds. A new dimension of the metropolitan area was needed which must take into account the city and its region to

form a new image for the city as a broad dynamic organism. As urban growth restricts environmental diversity the results is the movement of human communities from the center to the urban periphery which highlighted the importance of establishing a system of human settlements defined by spatial limits based upon movements or kinetic fields.” The urban elements impacting a precise policy for a city are the road networks, commercial centers, followed by the residential, recreational, and cultural structures. The dynamic city is the essential paradigm that must replace conceptual contrasts such as the condensed and spread-out city, or between the garden city and the cement city, or the contrast of city and country”

C. A. Doxiadis, *Ekistics*, 1968

3.2 Ekistics: The Science of Human Settlements

In *Ekistic: An Introduction to the Science of Human Settlements* (1968) Doxiadis argued that a dynamic and healthy human settlement is enabled by its ability to coordinate the expansion of its spatial structure and form with both economic and social relations across the local, regional and global scales. The task of Ekistics was to see that the human patterns of the small scale and the natural patterns of large scale can be merged into a total rational pattern (Doxiadis, 1962).

Ekistics for Human Settlements evolved as a synthesis of Doxiadis’ observations on regional science, town planning and the increasing role of cities in national economic development. The theory integrates the geographic, social and economic, and physical dimensions of human settlements to construct a rational and scientific evidence based planning approach.

The aim for Ekistics was to develop a technique to extend the synthesis of the small scale settlement to the larger scale metropolis and global ecumenopolis, where urban area was envisioned by Doxiadis to reach into millions. Three major areas of the city were identified to change over time, the main center of the city; the circulatory arteries which challenged movement; and areas surrounding very specialized places of

activity. A complete hierarchy of function from the lowest level of the family house to the center of the settlement was needed. Doxiadis argued that the dynamic growth of a settlement necessitated that additional nodal points, or points of central function be provided. The process of urban growth was characterized by Doxiadis to have initially a dramatic impact on the spatial character of a settlement with diminishing influence over time as the rates of change in both settlement size and form was to slow and remain constant unless man interfered consciously to change it.

3.3 Settlement Analysis and Urban Design Strategies

Ekistics was envisioned to be simultaneously a descriptive and prescriptive science. Mapping the development and evolution of the urban spatial system was critical to identify where areas of dynamic change were likely to take place. Doxiadis tackled the problem of handling an abundance of information, addressing the problem of decision making, and analysis of alternative programs and constraints of the urban system. The foundation of Doxiadis' urban design process was the scientific empirical analysis of the settlement, which would reveal the dynamic nature and inter-relationship of its function, which incorporated economical, sociological, and statistical studies in modern city development. The elements impacting the spatial formation of community class levels were, the size of population; the number of entrance points to the settlement; transportation structures; natural topographic features; the focal point or characteristic community facilities; and the number of communities of the next lower order. The influence of other centers in proximity to the community, and transport facilities were also of consideration. A hierarchical grading of communities was based on two variables

(a) average distance travelled within the community, (b) percentage of resident's trips outside of the community, by distance in excess of 1,500 meters.

The Ekistics method of planning began with the formation of a descriptive understanding of the existing settlement or city to uncover the laws which govern it. The prescriptive facet defined for Doxiadis a course of action to guide the settlements transformation by modeling new solutions.

New urban designs were based upon an analytical process of establishing the settlements history of spatial formation in relation to its *contextual forces*, which influenced the evolution of the settlements spatial form over time. Contextual forces were divided into two categories, *general forces* and *spatial forces*. General forces are not expressed spatially but typically related to economic, social, political or cultural contexts. Spatial forces exerted the greatest influence on the formation of human settlements, and were typically discerned through the analysis of the physical formation of the settlement, its function and relationship between multiple functions. Functions lead to the structure of settlements by shaping *shells* and *networks* which lead to the settlements form (Doxiadis, 1968).

All spatial forces were further characterizes as belonging to two types; *directional* and *non-directional forces*. Texture and density forms resulted from the operation of spatial forces within structure and form of the settlement. Densities forces were considered by Doxiadis to be the most important part of the study of settlement physiology. Two categories of density forces are identified firstly *texture forces* which define spatial relations and distribute people in uniform ways over any type of area often quantified as # persons per square meter area. The second category of density was

referred to as *directional forces* which draw people in certain directions towards points, lines, areas, volumes based on accessibility and convenience which can also be understood as concentrations and dispersions. The actual density was considered to be the result of a balance between texture and directional forces which are changing constantly night and day. *Texture forces* resulted from the combination of two Ekistic units (people, housing, villages, cities) upon the formation of a grouping of spatial forces and or Ekistic units. *Directional forces* result from the competition of many units and functions for the same locality and place.

Understanding the process of momentum of growth, intensity or scaling of spatial forces, and the interaction between spatial forces (understood as urban functions/ Ekistic units) was important to understand the how these forces would influence and generate major changes in the arrangement of the physical spaces of the settlement (Doxiadis, 1968). Doxiadis' analytical methodology was to create a sum-total model of the generative forces acting upon the physical spatial formation of the settlement which incorporated considerations of direction, intensity, and quality. The sum-total model first required the definition of the forces attracting or repelling the elements of a settlement towards certain points; and then the identification and measurement of forces connecting them. The most intricate aspect of this process is the definition of the relationship of the different kind of forces which depends upon general conditions of economy, social structure, political conditions, technological and cultural levels.

Discerning the basic structure of the settlement occurred through the *Force-Structure Modeling* of the settlement, which defined the relationships between different types of forces based on the criteria and values accepted by the settlements inhabitants.

The process of interpreting forces to structure was conditioned by determining the spatial area of the settlement which would depend on the ratio of directional forces to the texture forces. The ordering of spatial needs, functions, structure, form texture and density would be established on one directional axis, the other directional axis containing the nature of all needs. In addition natural forces (geographic, topographic and climate), Security conditions, and Regional forces characterized as positive-attraction and negative-repulsion forces, could be expressed as having diffused, central or linear spatial influence.

Through analysis the basic essential structure of a small settlement would be characterized as circular (one point for a center), geometric linear (one geometric linear axis), and non-geometric linear (one non-geometric linear axis). The centrifugal and centripetal characteristics typified directional forces as either, circular structures about a single center/node, and linear forces which developed linear spatial forms typically forming where there was no need for common services. Larger settlements are forms of composite structures derived from the basic ones through different combinations of directional and textural forces.

3.4 The Model of Dynapolis

The aim of the urban design strategy was to rationally organize the territory of the settlement to enable unhindered urban expansion while maintaining an optimum range of movement to urban functions. Strategic planning for the city-region depended upon the spatial form of the existing city which would be strengthened through the design of infra-structures, and the provision for transportation which binds the city to the territory. The

location of facilities was the main criterion to define boundaries followed by physical and manmade obstacles and public communication structures.

The dynamic city was envisioned by Doxiadis to expand gradually assuming a geometric shape (parabola) on the basis of a rectilinear system of axes, an arrangement that would maintain the center and periphery in constant balance. Growth was to be channeled in one direction by one or more axes which organized the process of aggregation of units. The development of the main axis establishes a link with the existing center to constitute the new urban center of the dynamically growing city. The local structure was redefined into a system of hierarchically arranged community classes based on kinetic fields of mans movement. With the increase in the scale of the settlement through the aggregation of community classes, increasing units of physical and social space would be constituted. The macro super-structure of the settlement was established through a singular axis. Key areas of the macro structure were identified as the historic center, the neighborhood, economic and commercial areas, recreation and green spaces, and a transportation network which supported an optimum range of movement for the present and future.

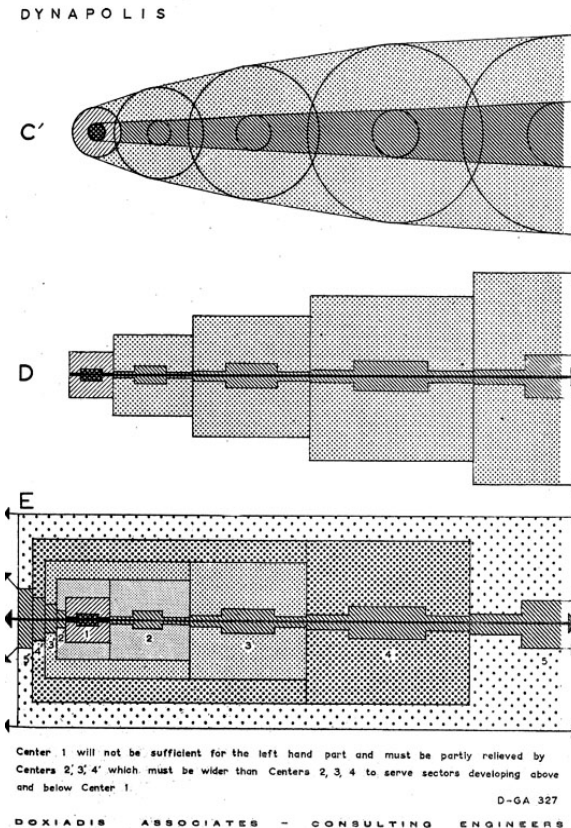


Figure 14 Sequential Growth of Dynapolis, C. A. Doxiadis

The parabolic idea of Dynapolis and Doxiadis' ideas on urban expansion resonated for Llewelyn-Davies with the scheme of linear cities (Llewelyn-Davies, 1967). Richard Llewelyn-Davies noted that the first attempts to add capacity for growth in the traditional concepts of town design led to proposals for linear towns such as Ciudad Lineal of Soria and Doxiadis' linear city.

“Until almost up to the present time it has been assumed that there is a basic size for a town or a community and that one of the tasks of planning is to limit or contain the town or community to that size. If plans are to be open-ended, and hold the capacity to absorb growth and change with the minimum of destructive stresses arising, then many traditional concepts must be re-examined to construct a theoretical understanding of the on-going pattern of growth and change in cities.” (Llewelyn-Davies, 1967).

Doxiadis disagreed with this classification as in his mind linear urban design was not feasible or functional, as any connection with functions not situated along the axis of the city would disrupt its uniformity and linearity as proposed by the initial design for a linear settlement. Doxiadis argued that his conceptual model for Dynapolis bears no relation to the linear city because;

1. The linear city can only exist for small areas, while the Dynapolis has no limits.
2. The linear city can be static, while the Dynapolis cannot.
3. The linear city has the same dimensions and formation at every point along its axis, while the Dynapolis has not.
4. The linear city grows in both directions, while the Dynapolis can grow but in one direction. There may be linear elements of settlements but not linear cities.

(Doxiadis, 1967)

Doxiadis' development of the grid spatial frame for a city was informed by the analysis of the ancient Greek city, characterized by its spatial organizing grid, open spaces, main streets and blocks, and distribution of functions. The Greek city usually located outside of the inner city grid the stadiums, sports facilities and theatre functions while preserving cultural, sacred, political and commercial functions within the interior of the city. Special provisions in the city plan accommodated the places of worship with whole blocks allotted to temples which were situated across the city in accordance to functional and aesthetic needs. Doxiadis viewed the Greek city to form a precedent for the concept of a modern city. Through analysis Doxiadis established that the location of temples was determined by the layout of streets, the synthesis of public spaces were not

determined by artificial geometrical criteria but only by man's own positions and movements which informed the measures of the city (Doxiadis, 1965).

Doxiadis concluded that ultimately the search for ideal solutions in urban design may not be found or able to be implemented, as an ideal solution must fulfill all aspects related to settlements, from its economic, social, administrative and managerial, to its technological and aesthetic aspects. Due to the passage of time and changing conditions, the ideal solution must be based on the needs of the future rather than the present (Doxiadis, 1965).

3.5 The Ekistic Community Class Hierarchy

The organization of territory outlined by the Dynapolis model established the city as a complex of interconnected and hierarchically arranged communities according to an Ekistic logarithmic spatial system. A single direction of growth defined by a dominant axis or central spine set out the rational order of the settlement. The model of Dynapolis allowed for the formation of multiple axes to form in tandem with the process of urban expansion to maintain an optimal range of movement. The development of new centers was to take place on the central axis, distributing new growth in one direction, to enable development concentrations while preserving the historical continuity of the settlement and its historical urban center.

Doxiadis believed that the inter-connected, hierarchically nature of social life, depended on the complex interweaving of the whole structure of the city and its ever expanding region. The Ekistic Community Class hierarchy sets out a relational Ekistic logarithmic scale of population and area based on five Ekistic elements, *Nature, Society, Shells, Networks, Anthropolos as individual*, and fifteen Ekistic units which were related by

the daily fields of movement optimized with an average radius of 200 kilometers (Ekistics, 1968).

Table 1 Components of the Ekistics Community Class Hierarchy

Community Class	Approximate Number of Families	Approximate Number of persons	Number of units of lower order	Typical Area Square Kilometers	Typical Trip Distance
I	15-20	75-100	-	0.01	0.1 km
II	60-100	300-500	3-6	0-0.4	0.2 km
III	300-400	1,500-2,000	3-6	0.2	0.5 km
IV	1,200-2,000	6,000-10,000	3-6	1	1.0 km
V	6,000-12,000	30,000-60,000	3-10	7	2.5 km
VI	30,000-60,000	150,000-300,000	2-10	40	7 km
VII	150,000-300,000	750,000-1,500,000	2-10	250	15 km
VIII	900,000-1,500,000	4,500,000-7,500,000	3-10	1750	40 km

Definitions of community classes are as follows;

Community

Class I This is the essential residential community formed by a group of dwellings on both sides of a street which can be either pedestrian or vehicular. The street is ideally to be a cul-de sac to ensure minimum traffic volumes (Dox-YUG-A1).

Community

Class II A group of communities of the previously described class. The connecting element in this case is a pedestrian road with a green area and a small park, with children's playground for use of the surrounding neighborhood. Along the road a few public facilities will be located. Collector vehicular roads connecting the cul-de sacs of the community class I areas are to constitute the boundaries for this community. This ensures that traffic will be kept on the periphery and will not hamper the central pedestrian movement (Dox-YUG-A1).

Community

Class III Four communities of the above described class will constitute one community class III. Here the main axis is a major pedestrian road connecting in a fishbone pattern the pedestrian roads of the previous communities. The described group of public facilities will be found in this road, the main element being the primary school (Dox-YUG-A1).

Community

Class IV This is the typical community, the 'human sector', developed around a center which includes such functions needed to cover almost all every-day needs. All houses of the community are in a walk distance from the centre. This residential unit is self-sustaining economically, commercially and culturally and yet still small enough for man, man on foot, to remain its master. This community may be crossed by a vehicular road giving access to the central areas. Again, the effort when planning the community should be to keep this road only for traffic of motors connected with this community and no through traffic should be allowed. The alignment of the road should be such as to permit the lowest possible speed. Naturally, the central axis of the central area of the community will be kept for pedestrian movements only and this axis will be extended to be the main pedestrian road of the community. Communities of this class are connected with vehicular roads of the higher order. The aim in planning the community should be to direct vehicular traffic to high speed roads which will be on one side of the community and pedestrian movement, or low speed traffic to the opposite side, where the centre of the higher class community (class V) will be located (DOX-YUG-A1).

Community

Class V This is a residential community of a higher order consisting on an average of four community class IV. Such a community is planned in all its aspects to meet the needs of human beings as individuals. Its centre includes almost all facilities necessary for the unobstructed operation of a small

city such as this community. Yet the maximum distance from the centre to any of the dwellings of the community is not greater than 2 km. This means that the centre will be accessible by foot, bicycle or low-speed busses, which will circulate within this community. Adequate green areas will surround the centre and will be connected with the centers of the communities of lower classes in which the said community is subdivided, thus ensuring a continuous system of green zones and pedestrian ways, connecting the residential neighborhoods' and giving the human scale to the community. The basic effort in planning the community should be to keep the traffic in it to the minimum possible level. As in the previously described communities this can only be achieved if the planning succeeds in keeping the fast and heavy traffic, which is not related to the community outside its limits. Only traffic which is concerned with the community should be allowed to cross it. The limit of this community is inscribed by the major road system of the city. These roads should be fast, continuous and straight as far as possible, allowing a quick access to any part of the city to places of work and the city center (Dox-YUG-A1).

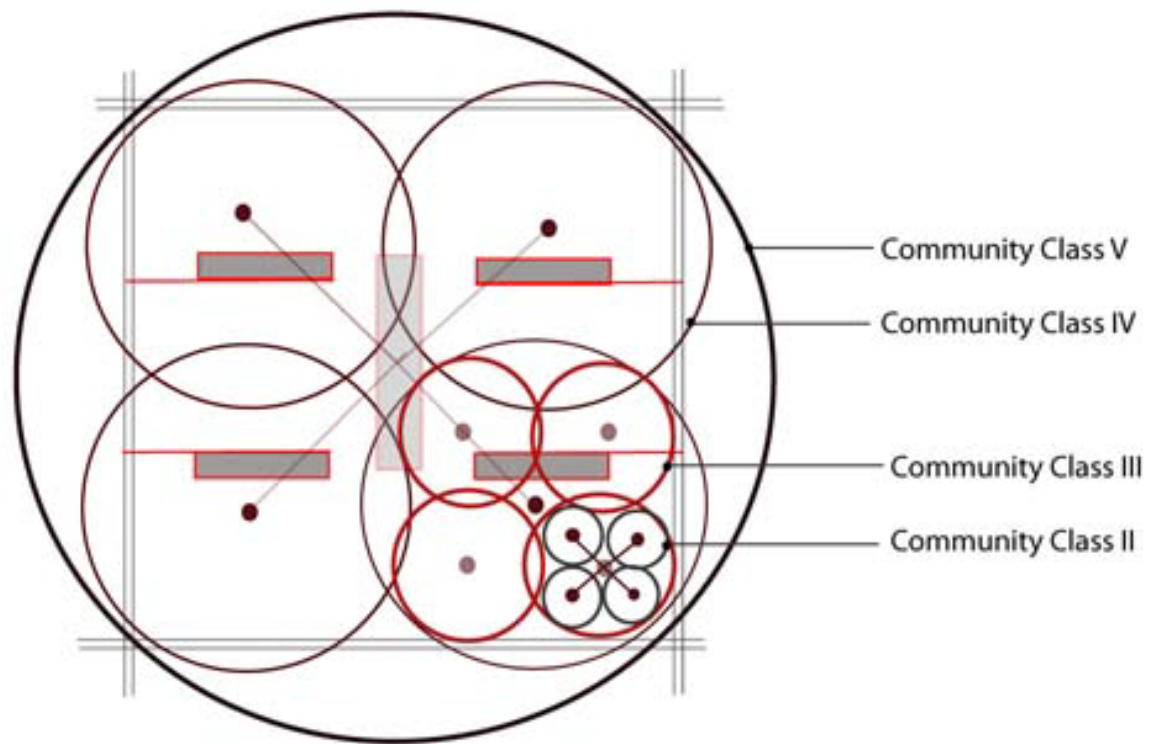
3.6 The Modulus: A New Dimension for the City

The *Modulus* rather than the block establishes the new spatial unit for Dynapolis, which forms in tandem with the transportation system super-structure. This spatial unit embodies a hierarchical weaving of communities to permit the rational planning of the city as an integrated system of transportation, commercial, open space, education and civic functions, and residential housing areas. The transport structure is the spatial framework inscribing modulus units and the clear legible spatial form of the city to create a clear hierarchical structure. The pedestrian scale is limited to the interior of the modulus with clear separation from vehicular traffic and is optimal in its movement range

to reach various functions. The local structure was established by a hierarchical series of community and district boundaries within the modulus. Ultimately the Modulus and the central axes were envisioned to generatively organize settlement functions and define its scale, and density, establishing one uniform pattern for the city which would blur the distinction between center and suburbs.

The Modulus, identified as the unit of Community Class V, was composed of a series of descending Community Class, VI, III, and II. The design strategy, establishes strong flexibility to define unique urban spaces on the interior of the modulus enabling the expression of unique social organization and culture, at the local scale of the community. The structure of community classes within a modulus are flexible and open to interpretation with opportunities for the Modulus to be completely specialized by function. Smaller plots can be recombined to form bigger block and bigger plot formation would allow for a more comprehensive development of building complexes.

Doxiadis argued that predicting urban growth was possible, and a dynamic approach was needed to redefine settlement density and establish new spatial patterns. The misunderstanding of the problem of densities had been the cause of very low densities in many settlements built and the aggravation of the poor service situation in them. Rather Ekistics established a correspondence between population and physical areas across successive hierarchical levels 1:7 (1:5-1:9) to form a logarithmic scale for the human settlement (Doxiadis, 1968).



SYNTHESIS OF RESIDENTIAL COMMUNITY CLASS V

Figure 15 Synthesis of The Modulus; A Community Class V © Middleton 2009

The Ekistics Center in Athens under Doxiadis worked extensively on the *Human Community Project* (HUCO). The HUCO project was an internal classified study undertaken in the early 1960's which aimed to develop a systematic approach to building relationships of optimum range between functions and movement, and define the delineation of spatial boundaries of communities. The mapping aimed to relate the location of every household with the location of the facilities used in order to obtain a visual impression of the resident's movements both in and out of the community. The measures developed in the HUCO project aimed to advance a method to estimate and compare average distances for efficiency and organization of Community Classes IV, and

the relative distance from higher order commercial centers to the scale of the central business district. In Athens the average distances for trips to average facilities in community scales was determined to be up to 1500 meters (Athens Center for Ekistics, 1964).

3.7 Spatial Strategies for Ekistic Human Settlements

Ekistics was founded on the premise that a dynamic and healthy human settlement was conditioned upon the ability of a city's spatial structure and form to expand in harmony across both economic and social relations, and from the local and regional to the global scale. The aim of urban design was to establish a balance between man and nature through a synthesis that optimize man's time, space and ability to maximize man's potential contacts with nature, people, and the built environment. The whole structure of the city is organized as a complex interconnected and hierarchically arranged series of communities. Urban expansion is rationally ordered by channeling central development along a single directional axis. Architectural unity is achieved through the grouping of buildings by height and volume. The buildings determine spaces which, being properly arranged into large medium and small spaces and suitably interrelated, will give life and interest to the center, attract the public and improve commercial activity.

Urban expansion expressed in a simple way, involves incremental growth of the urban structure of the city through a process of spatial aggregation. The increase in population results in the formation of multiple new communities. As population increases the demand on urban functions increase resulting in the expansion of service centers, commercial areas, and the need for adding additional and new functional elements to meet the increasing demands of the city. These elements establish a

symbiotic relationship that fluctuates over time and establishing their location across the urban structure was critical to enable their expansion and change over time.

Doxiadis' strategy was to establish specialized spatial units to form functional nodes for the urban complex. The four central urban design propositions establish the Ekistics design strategy for human settlements;

1. A single direction axis established clear orientation for urban structure to accommodate expansion. A dominant axis forms the central spine for the settlement with the possible formation of multiple axes with urban expansion.
2. The development of new centers, established on the central axis, distributes development concentrations and preserves the historical continuity of the settlement and its urban center.
3. The urban dimension of settlement expansion is the Modulus Unit (Sector) which is composed of a hierarchy of communities with associated circulation and infrastructure.
4. The transport structure established the spatial framework and defined the boundary edge of the modulus unit and internal community class structure. The pedestrian scale is limited to the interior of the modulus with clear separation from vehicular traffic.

Doxiadis' design objective was to spatially plan a coherent new type of human habitat dependent upon an urban structural framework. The rational strategy mediates the local structure constituted by man and a number of small settlements, and the regional macro structure of the metropolis, which was envisioned to encompass the super-structure of the settlement and its future expansion into its regional environs.

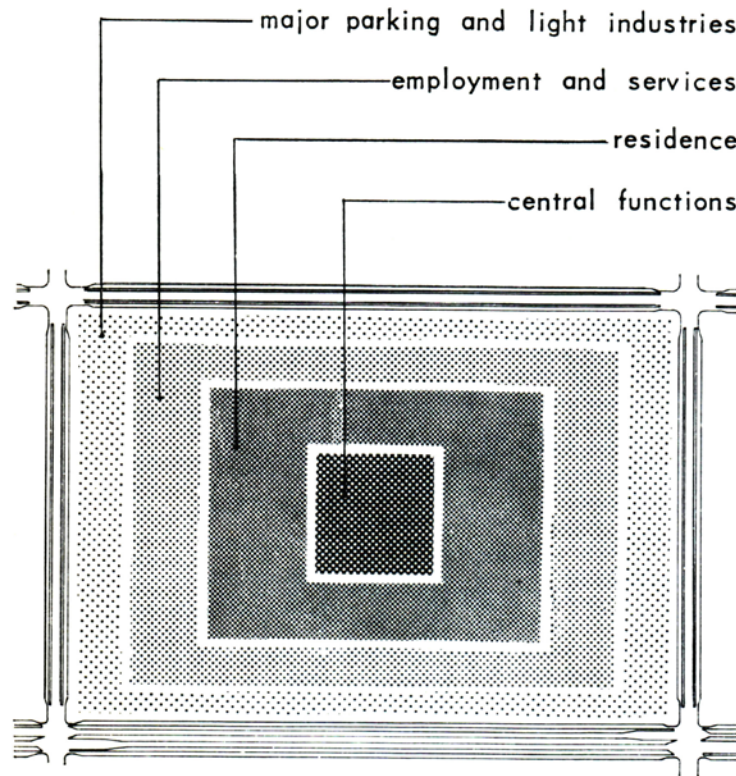


Figure 16 Design Strategy for a Static Change Resistant Modulus Unit © Doxiadis,1968

Reorganizing the existing spatial organization of the settlement was one of the first steps to establishing the new structural framework of the city. The second step was to apply a system of static and dynamic organization of the settlement, where functions, communication networks and transportation were organized outside of the modulus unit, rendering it as a static form that was no longer subject to continuous internal change. The design intent was to isolate the modulus from through traffic in order to allow functions to develop as they did historically within the old city – in a quiet, rather static way, independently of the functions surrounding them.

A second intention was to create a strong cohesion within the modulus, serving as many needs inside without attracting outside population towards its center. The modulus

was to be insulated from outside influences, and create obstacles for external influences and functions which may try to infiltrate the modulus by creating facilities and functions along the border line periphery of the modulus. Typically schools, sports grounds and parks, parking areas, garages and light industries were to be established around the border line of the modulus as insulating functions (Doxiadis,1968).

Various alternatives to channel dynamic growth of the settlement were generated through careful study of several analytical models, which elaborated existing trends of development. A range of models were used to establish projections of urbanization trends based on the change of land use, general growth trends, densities of habitation (residential densities) and population distributions, force-mobile, transportation models, cost models and projections of population distribution based on concepts of accessibility. Additional modeling of future forces that would impact the existing structure and form of the settlement were used to generate potential expansion scenarios. Doxiadis was cautious of the leading influence modeling could exert, clearly stating that methods of extrapolating present trends into the future must be carefully used, not in order to show where planning must go, but to find out where the spatial structure of the settlement is heading under present trends. The urban design process followed a precise methodology for the generation and selection of alternatives based upon the integration of different assumptions about population, densities of residences, work, transportation networks, speed and maximum travel distances, and optimal ranges of movement. To reduce the number of viable alternatives a filter of meaningful parameters such as the major functions, main transportation networks and identification of future important nodal points were considered to eliminate weakest alternatives. Selection of urban design

alternatives was structure by the objective to establish consistency and correspondence between assumptions relating to transportation networks and location of major functions, and force mobiles. Finally population distributions and cost modeling of the remaining alternatives was used to isolate the final urban strategy to guide the growth of the settlement (Doxiadis, 1968).

3.8 Urban Design Projects of Doxiadis Associates

Doxiadis was the central force propelling the awarding of the numerous international commissions to Doxiadis Associates. From housing studies to the design of town centers the finer details of urban life became integral to Ekistic urban planning. Many of the Doxiadis Associates urban design commissions foreground the regional and national development context, the economic sustainability of communities, and practical concerns for transportation, and infrastructures such as water and sewerage and the development of housing policy and programs. A brief survey of Doxaidis Associates projects reveals the integrated nature of the Ekistics practice to define the future spatial life of man, from the city and its region to the design of shelter and urban centers.

Islamabad Pakistan (1959-60)

Islamabad was conceived to be the new capital city of Pakistan located approximately 1200 kilometers north of Karachi. Islamabad was to accommodate the administrative functions of the new capital with Rawalpindi, and existing economic center to remain as the regional industrial and commercial center. The city is defined by two axes, one originating in the existing city of Rawlpindi, and the second axis established parallel to the Rawlpindi axis as the main spine for Islamabad establishing the

main corridor of expansion for the new city. The city is bounded by the transportation structure of the Margella Highway, Capital Highway and Soan Highway.

The Doxiadis master plan for Islamabad establishes the spatial extents of the city to cover an area of 1165.5 sq. km. and accommodates 84 -2 km x 2km square modulus sectors, with each sector planned to accommodate 20,000-40,000 people. At the center of each sector is the civic center spine, containing shopping, business and civic activities. The distribution of functions across the city follows a hierarchical system of distribution according to spatial scales which provides for the optimum access to functions by inhabitants of the sector. The sub-division of the metropolitan area into sectors resulted from the adoption of a hierarchical distribution of roads placed 2,200 yards apart in both directions with a full segregation of motor-car and pedestrian movement. The system of transportation is organized hierarchically (DA Bulletin,1964)

The urban design strategy incorporates the existing settlement of Rawalpindi by reshaping the existing road network in a way that established a natural flow of movement between the old and new urban fabrics. The plan of the city was based on the model of Dynapolis with a focus was on the street devising a hierarchy of movement, and the separation of functions brought an ordered perception to the city. This project has become the most renowned of Doxiadis' urban design based upon his Ekistics theory.

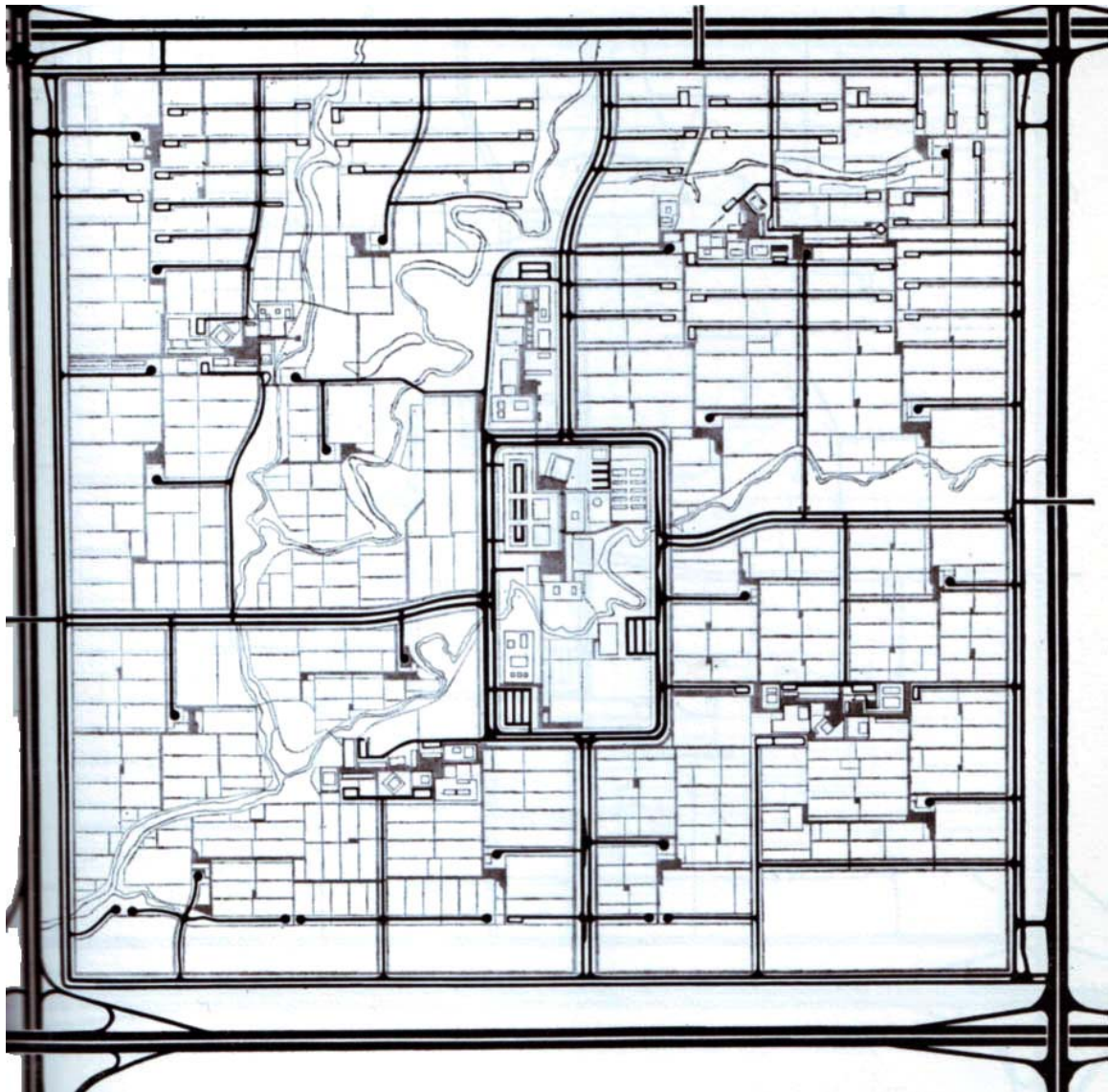


Figure 17 Typical Sector Community Class V Islamabad Pakistan, Ekistics 1968

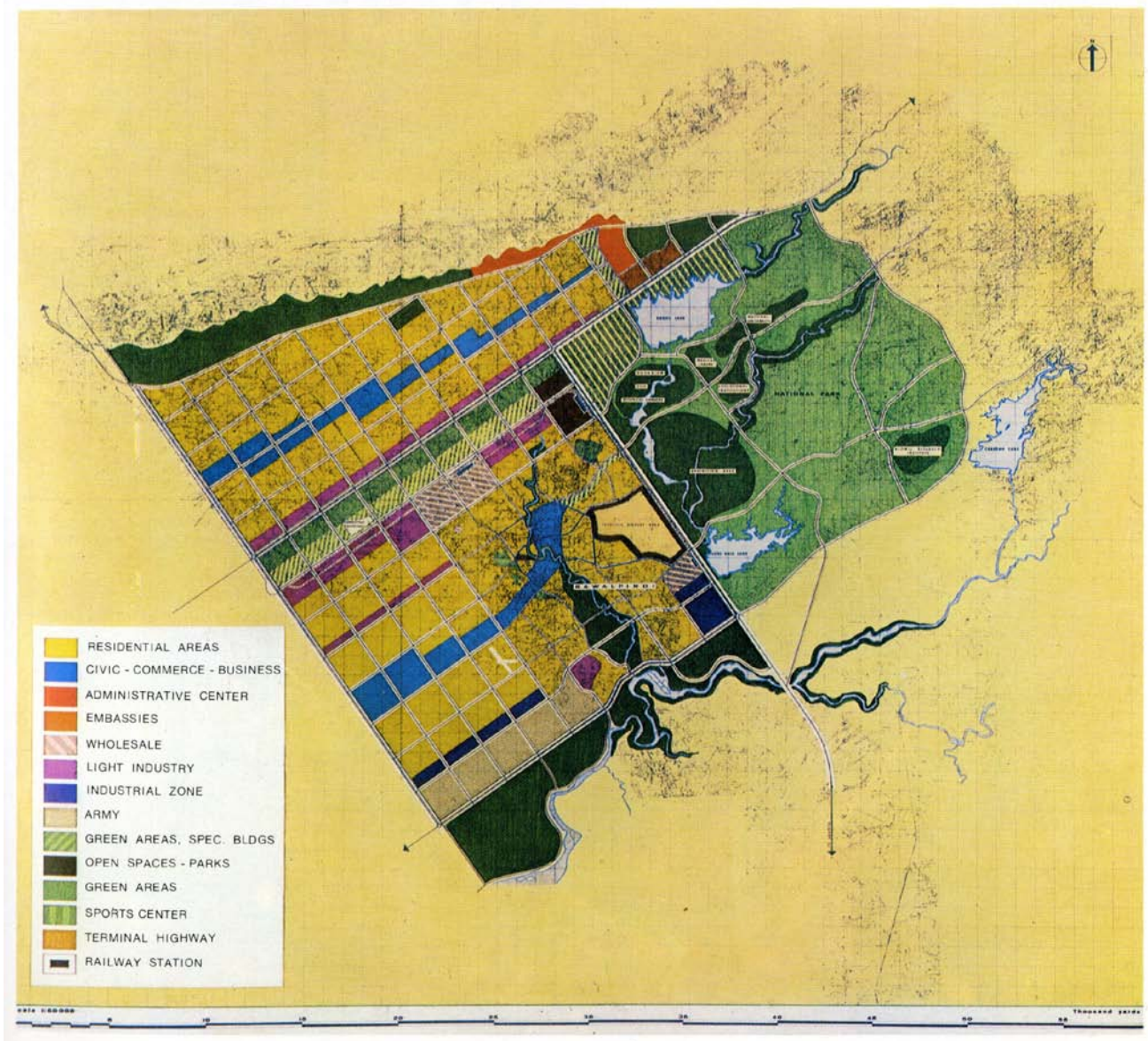


Figure 18 Master Plan Islamabad Pakistan © Doxiadis Archives

Saigon Vietnam, 1965

In 1965 the Director for Reconstruction, Nguyen Duy Duc, approved the firm Doxiadis Associates to undertake a comprehensive feasibility study for Siagon-Cholon Prefecture. The Doxiadis commission had several aims the first of which was to propose a reorganization plan for the prefecture followed by a 20-30 year development program for the metropolitan area. The second component of the study was to establish a comparative research on house-types suitable for Vietnamese environmental conditions, and plan for a pilot housing project of 1,000 houses. The pilot housing project establishes a single modulus bounded by the river. A complete urban structure would embrace the river as shown in Figure 19. Doxiadis Associates prepared a four volume report which outlines the existing conditions and challenges facing Saigon in its future development and the master planning options for the city. The project to prepare a National Development planning strategy for Vietnam was advanced by U. S. Agencies who aimed to control the scope and methods of development planning for Vietnam (Doxiadis,1965).

The master plan for Saigon establishes two parallel axial spines for the city which embrace the river by a series of bridges. The Doxiadis pilot plan for Saigon's new residential sector reflects the application of large block planning to order the peninsula assigned for the pilot. The river establishes the natural boundary to the exterior and interior land parcels of the sector. Roads and canals subdivide the territory into zones for residential, industrial, commercial and recreational uses. The main highway that links the peninsula to the surrounding territory of the larger city establishes the main direction for future expansion to the north east away from the river.

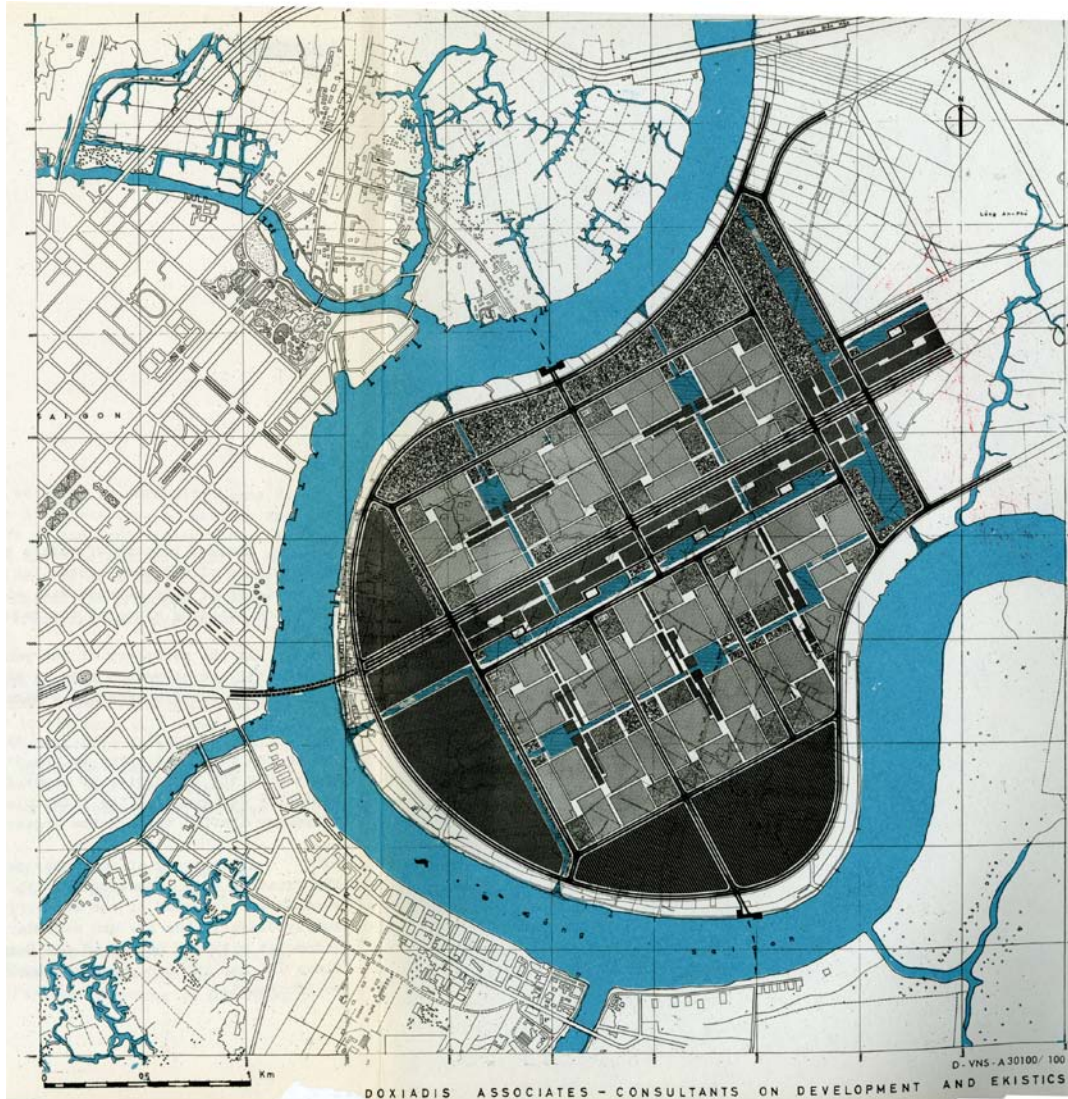


Figure 19 Community Class V Layout Plan Saigon © Doxiadis Archives DOX-VNS-A8 Vol. 2, 1965

The sector is divided into a northern and southern district with the northern district is subdivided into two community class IV areas, each with a functionally defined center. Both centers are linked to the main commercial spine by roads and canals. The southern district is inscribed with three centers which are linked together and connect to the river by small canals. Noticeable are the pedestrian paths, canals and open spaces which establish a secondary grid of movement within the modulus.

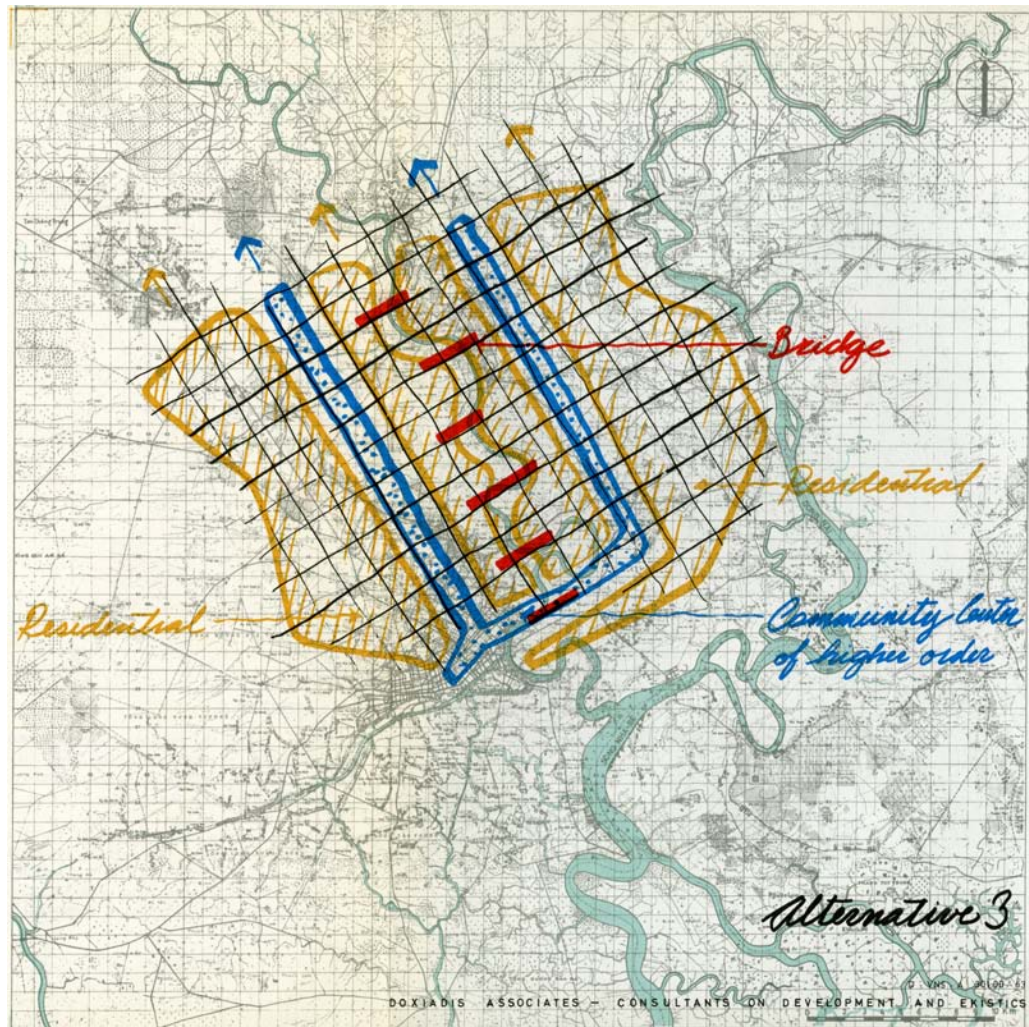


Figure 20 Saigon Master Plan Concept Alternative 3 © Doxiadis Archives

Tema, Ghana (1960)

Ghana achieved independence in 1957 and established its capital Accra on the coast. Tema was conceived of as an industrial city built 18 km from Accra and established to house a population of 250,000. The Doxiadis Accra-Tema Ghana master plan was approved in 1960 and is considered as one of the first modern cities in Africa. The spatial plan is organized according to function and service type where areas such as administrative and cultural buildings, the port authority buildings, apartments,

warehouses, commercial service, entertainment and shopping areas distinctly separate spatially and in their architectural forms. Pedestrian movement establishes the internal connective web crossing over the high speed transportation corridor which cuts through the high density center.

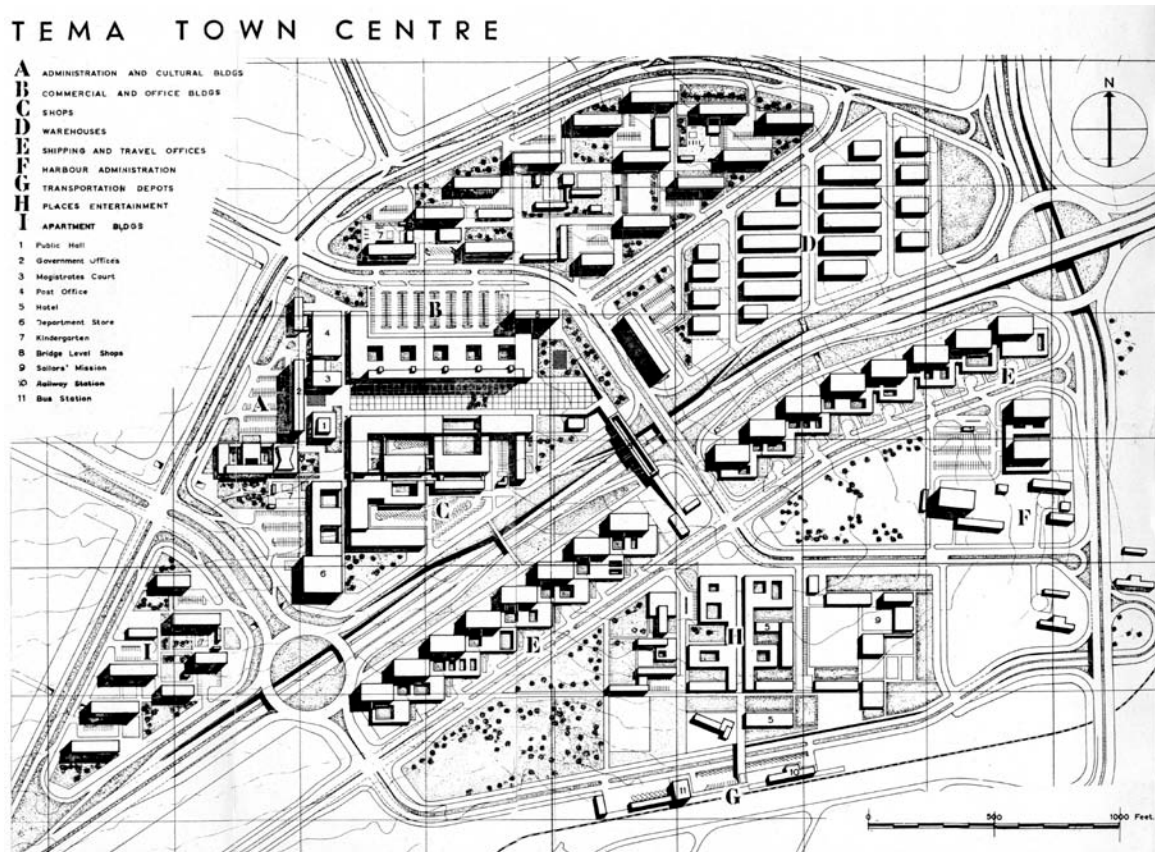


Figure 21 Conceptual Plan for Town Center Tema Ghana © Doxiadis Archives

The Tema Town Center plan for demonstrates Doxiadis' functional and architectural approach to urban design. A common theme across the majority of the plans developed by Doxiadis is the clear bounding of urban space by the transportation system which also was designed to enable rapid access to functional areas.

CHAPTER SUMMARY

Doxiadis considered the central problems of settlements to originate from their inability to adapt to the continuous and rapid process of urban expansion. Doxiadis Ekistic process defined a rational scientific planning methodology to define a resilient spatial strategy for the uncertainty of dynamic population growth, and spatial change. Doxiadis' design process began with the assessment of development forces and environmental conditions that have informed the evolution of the settlement. Through development scenario modeling he attempted to evaluate the effects of spatial planning on social and economic life, and the long term impacts of planning decisions on the environment, transportation, and subsequent spatial development and governance practices.

Doxiadis' Ekistics design methodology is one of the first approaches to comprehensive planning where multiple factors and their interrelationships became parametrically analyzed. Doxiadis focused his spatial planning on two spatial scales; the macro scale which included the city and its region, and the local community scale defined by functional orders of urban life spatially coordinated with an individual's optimum range of movement. The central design problem became how to unite and develop a synthesis between the two conceptions of territory.

'Dynapolis' was the urban design strategy to unite the macro and local territorial scales of the settlement and enable its ability to expand and change. The model establishes a macro urban structure defined initially by a single axial spine which would channel growth in one direction. Duality processes of dynamic and static urban change informed the spatial planning of the larger urban structure and the local community of the

modulus. Specialized moduli located within and adjacent to the axial spine of the settlement were designated to be the dynamic element of the settlement. Multiple axes could develop based on the optimum range of movement between a center and moduli. The local scale of the settlement was to be established by the modulus, a new urban spatial unit a 2 km x 2km super block district, which would accommodate up to 50,000 people and contain several imbedded community classes. The modulus was in designed to be a static spatial unit that inhibited movement and spatial change to ensure stability of the whole. The dynamic city was envisioned to expand gradually assuming a geometric shape of a parabola on the basis of a rectilinear system of axes and a linear transportation system. Multiple center node and axis would develop over time. The model of Dynapolis was conceived by Doxiadis as an organizing technology that rationally ordered territory and urban life, dictating the process and phasing of development according to a hierarchical structure of function, human and movement scales.

CHAPTER 4

THE FIRST MASTER PLAN FOR RIYADH KINGDOM OF SAUDI ARABIA 1968-1972

The Riyadh commission is an important commission within Doxiadis' urban design career, occurring eight years after the Islamabad project and in the midst of Doxiadis' publication *Ekistics for Human Settlements*. It is a significant project which has received no attention in the literature on Post-War urban design history. This chapter begins by situating Riyadh in its geographical, historical and social context with a brief overview of the city's development up to the Doxiadis commission, which is followed by a detailed description of the first master plan for Riyadh as prepared by Doxiadis Associates between 1968 and 1972. Key issues are the uncertain population growth rates and fragmented urban spatial character of the city. Chapter five examines in detail the Doxiadis urban design strategy specific to the organization of territory, connection strategy and the deployment of macro and local spatial frameworks and comparatively examines the MEDSTAR strategy.

4.1 The Historical Context and Geography of Riyadh

The city of Riyadh is situated on the Najd plateau at latitude 24' 38' N and longitude 46' 43' E in the east central part of the Arabian peninsula with an urban altitude ranging between 570 and 690 meters above sea level. The city is bounded to the east and south by major steep escarpments and to the west by the Wadi Hanifah, the main and immediate topographical feature of the surrounding region (MEDSTAR, 1999).



Figure 22 Map of Saudi Arabia

Numerous Wadi's surround the city joining in an area to the west of the city, Wadi Qaddiyah, Wadi Wubayr which flows south-west to north-east, and Wadi Al Aysan which flows north-northwest to south-southeast. As seen in the 2001 satellite map figure 15, new urban developments are forming to the west of Wadi Hanifa, to the north west and to the north east of existing urban areas. The city's present urban form is characterized by the adaptation of a grid organization of territory specific to natural terrain and topographic features. The climate of north and east central region of Saudi Arabia is extremely arid experiencing high temperatures with low precipitation, and high solar radiation and is characterized by dry and long hot summers, an cold winters (Doxiadis, R-Sau-RD1968).

Riyadh's rapid growth as a settlement began to accelerate in 1902 during a period of unification and sedentarization referred to in Saudi Arabia as the 'Ikhwan movement'.

This strategic initiative undertaken by Abdul Aziz aimed to settle and unify the one hundred nomadic tribes who controlled various regions of the country. J. B. Philiby who visited Riyadh and the southern Najd in the late spring of 1917 described the city as “completely encircled” by mud walls of about 1,700 meters in length and 7.5 meters in height. The town was built without regard to symmetry and surrounded by a considerable expanse of palm groves and gardens. Nine gates perforated the defensive walls of the settlement. Philiby’s estimate put the population of Riyadh in the order of 12,000-15,000 persons in 1917 (Philiby, 1920).

Establishing peace and unity between the many tribes was a key political strategy leading to the control of most of the Arabian Peninsula by Abdul Aziz by 1926 (Al Hathloul and Edadan, 1993). In 1927 the Treaty of Jeddah was signed establishing the British recognition of the Kingdom as a sovereign state with Abdul al Aziz al Saud proclamation as King established on September 23, 1932. The Kingdom of Saudi Arabia’s present boundary and aerial control was completed by the Treaty of Taif dated 1934 (Al Hathloul, 1981).

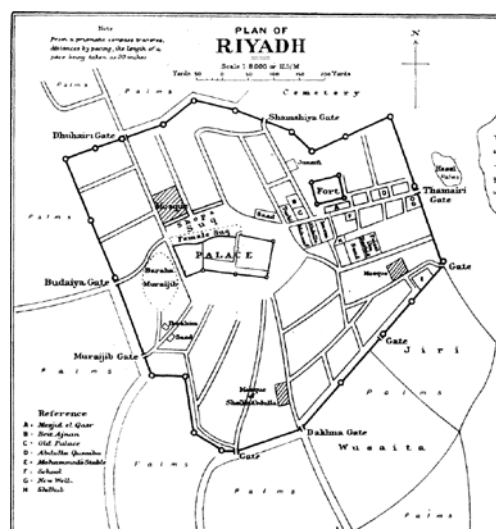


Figure 23 J. B. Philiby Plan of Rivadh 1917

Three periods of development are commonly noted in Saudi Arabia's urban development history. The First Saudi State (1744-1818) was established in Dir'iyaha small settlement located twenty kilometers north west of Riyadh; the Second Saudi State (1824-1891) founded by Turki Bin 'Abdullah bin Muhammad bin Saud, who upon regaining control over Riyadh, reestablished it as his political center; and the establishment of the Third Saudi State by King Abd al Aziz al Saud(1932). More recent historical accounts highlight the regional distribution of urban development and its ties to the emergence of political unification under King Abdul Al Aziz and the influence of industrial oil production (Al-Hathloul, 1981, Edadan, 1993). Saudi Arabian urban planning history is typically characterized by a temporal or periodic phasing of urban development organized around institutional organization, socio-economic production capacity, spatial division and demarcation is common.

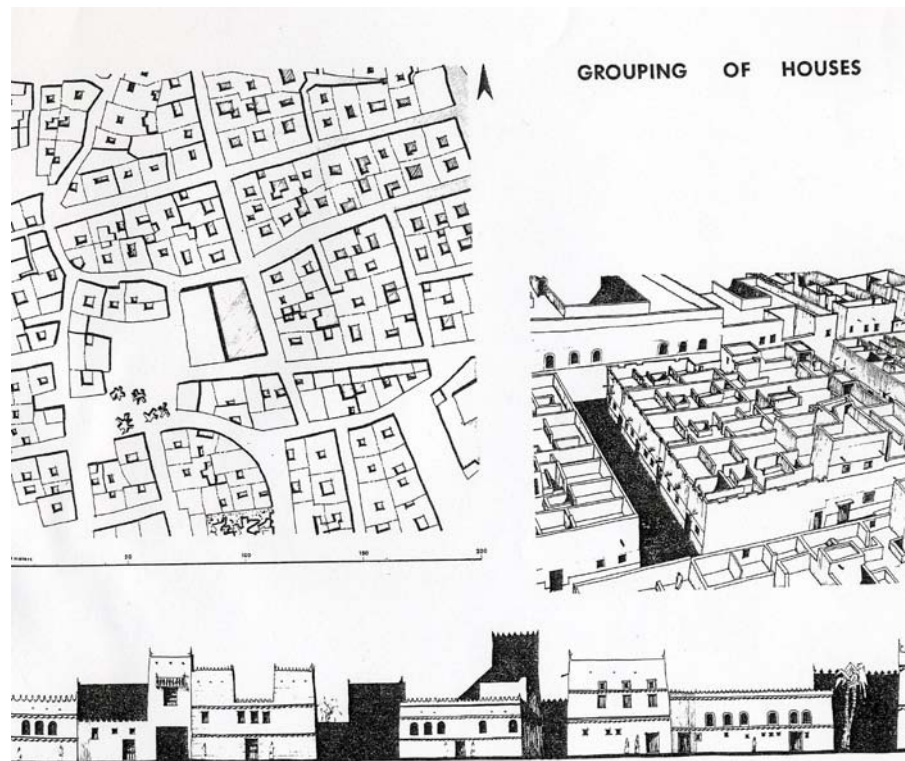


Figure 24 Traditional Form of Riyadh Saudi Arabia © Doxiadis 1968

The spatial structure of the older districts of Riyadh are characterized by small neighborhoods composed of blocks of houses, which reflects a composition of rectangular buildings with interior courtyard which covers the whole plot. The plot dimensions are almost 10 m x10 m sq. or 10 m x 12 m sq. and the depth of the building around the courtyard is approximately 3 to 4 meters. This formation typically develops on either side of a main road 8-12 meters in width. Small squares with low shops and a mosque establish the focal point for the pedestrian. In the 1950's mud brick construction materials were replaced by concrete, a trend that was becoming one of the greatest influences affecting the planning of residential communities (Al Hathloul et al, 1975).

4.2 Riyadh's Functional Importance as a New Capital City

As the Kingdom's capital city, Riyadh is an attractor bringing regional development and increased flows of migrants to the Najd region. Beginning in the 1940's all key Government Ministries located on the Red Sea coastal city of Jeddah were relocated to Riyadh propelling the city's expansion. Since the 1940's numerous developments such as the first international airport and railway, and the Murabaa Palace district built to the north of the original walled city have influenced Riyadh's spatial form. The development of urban transportation infrastructure from a modern railway and highways, to a new international airport strengthened the cities connectivity across international, national, and regional scales. New boulevards linked the airport to the center of the city and to the Murabba Palace area and became the preferred location for the construction of Ministries, Palaces and multiple modern buildings.



Figure 25 Al Malaz District, Arriyadh 1953

The city's first modernist neighborhood is the grid iron Al Malaz, a new residential district constructed in 1953. Al Malaz became the most prominent modern development in the city, sponsored by the Ministry of Finance to accommodate the middle and high income class employees relocating to Riyadh (Al-Said, Fahad, 2003, Al Suliman,T. 1989, Al Hathloul et al, 1975, Al-Hathloul, 1981). Positioned 4.5 kilometers north east of the historic city centre and covering an area of 500 hectares, the Al Malaz urban design was based on a grid iron and consisting of three districts accommodating 180 apartments and 754 detached dwelling (villa style). Functionally the district was to provide a public garden, a municipal hall and public library, with adjacent football fields and a public zoo and race course. Al Malaz (shown in orange in Figure 26), the new airport and train station became significant developments influencing the organization of

land and development patterns through their connections to the existing city by new roads.

Government Ministries and Courts were built and distributed across the city, located along the main road connecting the city center with the new airport. New spacious public administrative buildings typically 4-5 stories in height began to be constructed across the city with the majority located on Matar and Nassiriyah Roads or in the old city center around Dira Square. The integration of new buildings in the existing central business district and the subsequent increase in traffic pressures was resulting in a continual perforation of the mud defensive walls and destruction of historic city buildings. At the time of Doxiadis' review of existing conditions new construction of Ministry buildings along Matar Road, Royal residences in Nassiriyah, the construction of a new large hospital, and the expansion of industrial and manufacturing areas was underway (Al-Hathloul, Saleh, 1981).

4.2.1 Economic and Social Development

Improvements in economic conditions due to the emergence and expansion of oil exploration and the development of secondary petroleum based industries propelled the rapid growth of the capital city. The expansion of the economy resulted in the rapid development of urban living conditions, provisions of education, health and social services. Sedentary urban lifestyles and the conveniences offered increasingly became attractive to the Bedouin experiencing the uncertainty of nomadic subsistence.

World War II found the Saudi Arabian economy still at an early stage of development with levels of production and income hardly above the bare minimum for subsistence (Doxiadis Assoc.1968;D). The annual influx of pilgrims was the only

important economic activity which provided a certain amount of foreign exchange vital for the economy. Oil prospecting and exploration had begun in 1923, with the first commercial quantities of oil discovered in 1938. In 1939 the Saudi Arabian government's revenue from oil production did not exceed 3 million U.S. \$, while the taxation revenue from pilgrims was in the order of 4.5 million U.S. \$. The impact of oil revenues on the economy became more pronounced with the resumption of oil prospecting immediately after the Second World War. The impact of Saudi Arabian oil revenues from 10 million U.S. \$ in 1946, to 56.7 million in 1950, exceeding 340 million U.S. \$ by 1955 resulted in the rapid rise in the standard of living in the capital and regional urban centers.

In the years 1950-1955 the Kingdom experienced unprecedented growth with a rapid increase in development expenditures. The oil revenues fluctuated and fell below the 1955 level in the 5 year period up to and including 1960 and a balance of payments crisis occurred in 1956-57 which was answered by a stabilization program launched in 1958. At the beginning of 1959 the Saudi Riyal was devalued by about 12.5 percent down from S.R. 3.75 to 4.50 S.R. per U.S. \$. (Doxaidis Assoc., 1968). The Saudi Arabian economy since 1961 has managed continuously expanding oil revenues, expenditure and incomes. The Kingdom's G.N.P. in 1960 was estimated to be of the order of 4.3 billion S. R. and the annual rate of growth was estimated by the Saudi Arabian Monetary Agency to be about 10 percent for the 1960's.

Riyadh's economic growth has been much higher than the rate of economic growth for the country as a whole increasing by at least 126 percent in the period of 1950 – 1968. In tandem with economic development, the Kingdom emphasized the

development of educational and health institutions across the country which continues to the present day. Saudi Arabia's social and cultural character reflects a strong family oriented society, a force which continues to shape public and private architectural and urban space.

4.2.2 Transportation Development

The new government capital began to increase the scale and speed of urban development with the advance of transportation infrastructure. The railway completed and inaugurated 1951, was located to the south east of the city and linked Dammam to Riyadh. A new airport was built to the north east of the city center. By 1950 commercial development was concentrated on major roads that connected palace districts to the airport, and to the central business district. These developments effectively elongated the spatial structure of the city in a north eastern direction. The inner city roads were a combination of asphalt and gravel and the increasing presence of automobiles began to reshape movement patterns of the population. Traffic congestion, parking and pedestrian safety was a mounting problem.

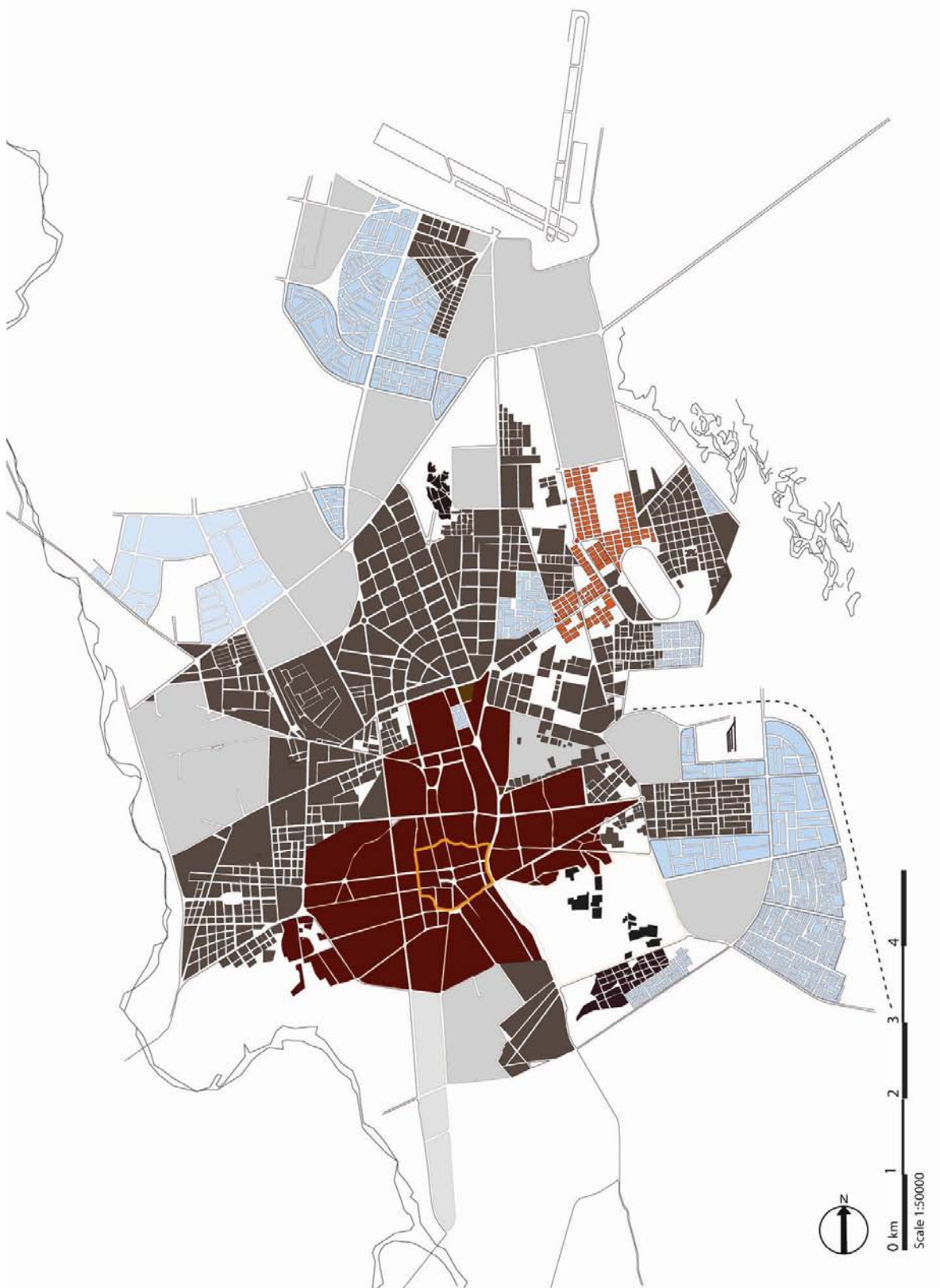


Figure 26 1968 Urban Extents of Riyadh Showing Future Expansion

4.2.3 The Development of Saudi Arabia's Urban Planning Institutions

In 1932, the year of national unification, laws became enacted establishing Riyadh as a municipality followed in 1937 with the Capital and Mayorship Act which specified responsibilities of municipal administration. The Emirate Act followed in 1939, re-ordering the administration of regional areas and nationally organized the Kingdom into 13 Emirates headed by administrative Governors who represented the central government. During the period 1932-1950 planning actions focused on the creation of management agencies and on regulatory reform (Garba,2004). National urban policies did not appear until the 1970's when master plan for cities were prepared and approved.

The greatest factor impacting the development of national and local planning institutions was the lack of resources prior to the commercial production of oil in 1953. The fundamental challenge during the period became how to develop institutional frameworks for management in the face of rapid growth and increasing demand for services. A Directorate of Municipality was created in the Ministry of Interior in 1953 and in 1962 it was elevated to the Department of Municipal Affairs. H.R.H Prince Salman bin Abd al-Aziz (b.1936) was appointed Governor for the Riyadh region in the late 1960's and continues today as Emir and Governor to expand the planning institutional framework and vision of development for Riyadh and Saudi Arabia. The council of Ministers created a technical committee chaired by Riyadh Governor Prince Salman bin Abd al-Aziz to oversee the implementation of the Doxiadis master plan. This committee subsequently became the High Commission for the Development of Arriyadh, with the technical planning nucleus forming the Arriyadh Development Authority.

4.3 Doxiadis and the Commission for the First Strategic Master Plan for Riyadh

The master plan study for Riyadh was assigned to Doxiadis Associates at the end of 1967 A.D. by the Town Planning Office of the Ministry of Interior for Municipalities. The final master plan was adopted by the Saudi Arabian Council of Ministers in 1972. Saudi Arabian intent for the master plan commission was to establish an urban strategy to guide and enable Riyadh's expansion and development to the year 2000. The scope of the initial project as defined in the contract was twofold; first to prepare and present three phases of the study of a master plan and report for the development of the city of Riyadh up to the year 2000, taking into consideration the long-range developments of the urban area within its geographical surroundings, and second to prepare and present two phases of study of community layout plans and of a report for the development of selected existing and new areas in the city of Riyadh.

Doxiadis proposed to study the origins and past growth of Riyadh, and the forces propelling growth in the last decade, role of the city in respect to the whole country, potentials for development up to the year 2000. Through a 'correct' appraisal of traditional urban patterns and architecture, develop design principles that may be used in the development and the design of near urban areas. The mandate to develop community layouts expressly requested that a phasing plan for development be set for the coming 10 years based upon a standard design for central public spaces for communities for an approx. population of 10,000 persons.

On Saturday, Feb 10, 1968 Doxiadis Associates established their project office on Thahrar Road, Malaz 884. Immediately upon establishing the project office, the process of conducting visual surveys, collecting data and maps and holding a wide variety of

meetings from various Ministry and Municipal Officials to UN consultants on development began. The Riyadh D A project team was under the guidance of C. A. Doxiadis, S. C. Chatiras and A. Simeon and included, Mr. N. Efessios, C. Antahopoulos, P. Pappas and I. Frantzeskakis who arrived in Riyadh on Sunday January 21 1968, followed by Mr. P. Mitsanis, I. Dimitriou, Sp. Theodossopoulos. Additional team members in Athens were Nikitopoulos, F. Basteas, Cartzos Jordanidis, and J. Broumis (Doxiadis Associates, correspondence, 1968).

The first project meeting was held on January 21, followed by intensive meetings on the 23rd 1968 at the Ministry of Interior for Municipalities chaired by the Deputy Minister Mr. Abdullah Sudeiry and the Director Mr. Yusuf el Waheideh, and on the 24th at the Municipality chaired by the Lord Mayor Sheikh Abdul Aziz El Thanaïen. Other officials included municipality design officer -Mr. Rassem Shaath, the central statistical office -Mr. Ali Rashid, Director- Mr. Nazir Ahmad, Mr. Aslan and the Directorate of Roads in the Ministry of Communications -Mr. Jubair, who was also the U.N. advisor.

Numerous meetings between the Doxiadis Associates and individual Government Ministries followed throughout the course of preparing the master plan. Notable meetings occurred with the Ministry of Social Affairs representatives Mr. Mare Sailier, and Mr. Nabil Diwani who initiated discussions on housing proposals, General organization and program of research and planning work was coordinated with the Director General of the Ministry of Interior for Municipalities Mr. Yussef Wahedeb, and Mr. Linjawi accompanied by Mr. Omar Kadi representing the Inspector of Town Planning Office. The Ministries of Education, Labor & Social Affairs and Health, and the Central planning Organization and Central Statistical Department were visited by the D A

Team to collect publications and information concerning the master plan study for Riyadh. Doxiadis Associates were also in frequent contact with numerous Departments for information on existing and future extensions of water supply, sewerage and drainage systems, with subsequent questions addressed to the Deputy Minister of Municipal Affairs. Plans underway for the updating of the new water supply system of Riyadh were provided to Doxiadis Associates by Mr. N. Skiadas of BOKAT contractors for the new water supply system of Riyadh. Plans for the development of new industries by Petromin were shared with Doxiadis Associates on June 20, 1968. The Lord Mayor Sh. Abdelaziz el Thanaiyain initiated discussions with Doxiadis Associates seeking their advice on the proper location of the athletic center which was commissioned to architect Kenzo Tange; the location of the airport and the undertaking of design proposals for the redevelopment of the old center of Riyadh which was to propose strategies for the preservation of the distinctive old sectors of the city. The assignment to undertake the feasibility study for a new airport and its relation to the city was also discussed with C. A. Doxiadis during a November 1968 meeting with the Minister of Defense and civil Aviation and acting Minister of Interior Prince Sultan ben Abdul al-Aziz, who was assisted by Deputy Minister of Interior for Municipalities, Mr. Abdulla Sudairy and Lord Mayor of Riyadh Sh. Adbel Aziz Thanayen, Also discussed was the identification of an area in the suburbs of the city proper to accommodate the Government's subsidized residential development of 7,000 family homes for low and middle income groups (Doxiadis Associates, correspondence, 1968).

4.4 Existing Conditions 1968

Riyadh Existing Conditions – Final Riyadh Master Plan Study, A brief account of the Report on Existing Conditions. July 1969 was prepared in the course of the first six months of study and synthesizes information from surveys and direct field investigations as well as data collected from Government Ministries and the Municipality. Numerous Saudi Arabian officials and consultants were involved in guiding efforts to undertake the Survey of Existing Conditions and evaluating scenario's for the Final Master Plan. The Report of Existing Conditions touches on the origins and forces underlying the growth of Riyadh in the past few decades with a specific focus on the most recent developments and the role of the city with respect to the country as a whole and its potential for development was assessed as was the city's transportation, social and community services functions (Doxiadis Assoc.DOX SAU-A1-4., 1968).

When Doxiadis arrived in Riyadh in 1968 the city covered an area of 85 square kilometers in 1960 and was rapidly encompassing a number of peripheral settlements such as Manfuh. A radial pattern of city expansion was occurring about the city center. New residential areas were forming along the extension of principle streets and large parcels of land were under development planning as shown in blue in Figure 26. Major functions attracting heavy traffic were identified as the central business district, the districts of Murabaa and Shamsiyah, industrial areas, and the area of the Ministries along Matar Road.

All the computer classifications for the Household Sample Survey and the Transportation Survey were compiled in a separate volume, and bound together with the tabulations of the Town Planning Office Survey carried out in 1965-66. The analysis of

the inherent forces in the growth of the city, were also coupled with an economic outlook of its present and future employment and generally economic activities. This volume accompanied the Report on the Existing Conditions of Riyadh, submitted to the Ministry of Interior for Municipalities. This report forms the factual foundation on which the Riyadh Master Plan was based. It was followed by meetings confirming the factual foundation of the data contained and agreed upon forming the stepping stone for the Master Plan policies, standards and projections (Doxiadis Assoc. MPR-SAU-RD, 1968).

Various Ministries and the Municipality shared urban and social data and statistics compiled from previous surveys and audits. The Town Planning Office Survey of Buildings prepared in 1965-1966 by the Riyadh Town Planning Office of the Ministry of Interior, provided a block by block survey of buildings. The main traffic arteries, major functions and land uses were recorded on city map at scale 1/10000. Doxiadis Associates supplemented these data sets with The Household Sample Survey and The Transportation Surveys both of which were carried out between May and June 1968. Doxiadis' methodology for the analysis of Riyadh, subdivided the city into 10 districts, 24 sub-districts and 224 segments. The pattern of divisions that were adopted was based on divisions that had previously been proposed and used by the Central Statistical Department. A total number of 2,571 interviews were conducted a sample of 5 percent of the total number of households of Riyadh, listed as 12,808.

In 1930 Riyadh's population was estimated to be 30,000 growing to 80,000 by 1951 reflecting a 4.5 percent average annual rate of population increase (DA,1968:B). The Town Planning Office produced a profile of demographic change for Riyadh from 1935, 1951, 1963, 1965 based on data estimates. As of 1968 a population census had not

been undertaken by Saudi Arabia. The official Saudi Arabian estimate at this time of the country's current population was between 5 and 10 million persons, a number which far exceed the 3.3 million person calculated by the Ministry of Finance Survey of Population conducted in 1962/63. By the 1940's Riyadh's size grew to 8.5 square kilometers, extending 4 kilometers from the east to the west, and about 3.5 kilometers from the north to the south (Al-Sahhaf, 2000). The population of the town and the number of dwelling units almost doubled through this decade, from 46,000 to 81,000 inhabitants, and from 6,505 to 12,297 dwelling units (Al-Khalidi, 1992, Al-Sahhaf,2000). This resulted in the rapid expansion of Riyadh pushing the construction of new dwelling units from 12,000 in 1950- 29,000 in 1960, with the city population increasing from 84,000 to 151,000 in the same period (Al-Khalidi, 1992).

The period from 1951-1973 is considered by many historians as well as economists to be the starting point for Riyadh's exploding urban growth and expansion. Historically two factors influenced the development of the city, the first was the relocation of ministries resulting in population shifts to the Najd region, external migration in the Arab world induced by war as in the case of Egypt; and the change of the world economic order that produced the proliferation of migrant populations into Arabian Gulf states (Abu-Lughod, 1978 in Al-Sahhaf, 2000). A seven year severe drought from 1958-1965, resulted in large numbers of Bedouin relocating to Riyadh to seek alternative livelihoods in the rapidly developing construction and oil industry.

The problem of establishing the rate of population expansion is especially pronounced across the Doxaidis Associates' project correspondence. The challenge was three fold, establishing an accurate population count for 1968, establishing the rate of

expansion of the city across the decades previously, and forecasting the potential population of the city for the future up to the year 2000 and beyond. Doxiadis noted that the population projections in use by various public agencies required revision downward.

The Report of Existing Conditions notes that the total population of Riyadh living in private households is approx. 281,000 persons. Over the last 40 year period the population growth has increased by twelve times. The population growth rate is attributed to migration, comprising 50 percent of the population of Riyadh in 1968. Three official surveys were undertaken between 1962-1965, reflecting dramatic variances with a seven percent average annual growth rate for the period of 1951-1962 was calculated but a rate of nearly ten percent for the period between the first and second survey and a rate of nearly 8 percent for the period between the second and third survey was found. Impressions of informed local sources raised the rate in question to more than ten percent, considered by Doxiadis Associates to be an overestimate (Doxiadis Associates, 1968) who argued that average annual rate of population increase of the city of Riyadh in recent years reflected an 8 percent increase. Informed authorities in Riyadh put the birth-rate at 40-45 percent and the death rate at about 20 percent allowing for a natural rate of population increase of about 2-2.5 percent per annum. The difference between the natural rates of population increases was attributed to immigration. Riyadh's population growth was expanding at a rate of 9 percent per year. In principle, "...the municipal area should be sufficient to accommodate the population of the city at a reasonable density."(Doxiadis Associates,1971). Observations by Doxiadis Associates specific to the explosive population growth establish estimates the rate of expansion to be 8 percent per

year between the years of 1960-1966, and based on this rate an estimate of 1.8 – 2 million people by 2000 would occupy the city.

The Transportation Surveys revealed traffic volumes, and trip characteristics such as origin/destination and trip lengths. Special extensive surveys were carried out in order to provide solid and reliable facts on the present day traffic and travel characteristics of Riyadh. This information was analyzed to form a basis for the subsequent formation of a program of function for prioritizing urgent needs. The road network was classified according to the hierarchy of major and important roads. A copy of the report of SAUTI, concerning the improvement of urban roads of Riyadh, borrowed by the Municipality's City Engineer was sent to Athens (Doxiadis Assoc.C-SAU-RD 241, 1968) and requests were made to the Ministry of Finance for the provision of the relevant issues concerning building and road regulations in some areas of the city. The Municipality advised on plans for improvements of some roads in the city and a general lay-out with a priority list, showing the roads to be improved, was given to Doxiadis Associates for consideration (Doxiadis Assoc. R-SAU-RD,1968).

The Household Sample Survey, organized by Doxiadis Associates and carried out with the assistance of the Central Statistical Department of Saudi Arabia was conducted from February through May 1968 and is a cornerstone of Doxiadis' approach to settlement design used to establish community boundaries and locate shared communal functions such as schools, health clinics, and commercial areas. The survey was conducted in close cooperation with the Central Statistical Department. The Household Survey sample was established through the subdivision of the city into a limited number of strata based on existing zones established by the Central Statistical Department. These

strata where further divided into blocks, with or without listing of dwellings. These administrative sub-divisions enabled data to be compiled from new and previous surveys. Densities of the city according to Haras (sub-districts each roughly equivalent to a double Community Class IV) were worked out and recorded on map at 1/10000 (Doxiadis Assoc. R-SAU-RD, 1968).

Existing Town Planning and Building regulations were outlined in a book titled *Road and Building Regulations*. Doxiadis Associates received a copy from Mr. Saud Linjawi's personal bookcase in 1968, and following the recommendation of Mr. Rassim Shanth, the city Engineer of the Municipality, undertook an official translation. These Regulations were considered to be based on Egyptian Planning Standards, directed the construction of houses and buildings, the height of the fence wall, outlining minimum floor areas and size of windows. Town planning regulations specific to the use of areas according to divisions, building line and massing and height regulations for buildings were not available or did not exist except in cases of the new developed areas such as Al Malaz. No relevant regulations concerning zoning and land uses, or outlining development of new residential or industrial schemes could be found. Densities in various sub-districts were estimated on the basis of the surveys of the Central Statistical Dept. and the Town Planning Office. The 1968 Building Survey estimated 51,200 households or dwellings units not including 'temporary' housing, a substantial increase from the 1965-66 estimates of 38,200 households, which reflects a dramatic increase in the growth of the city.

A topographic mapping of the urban region area to a minimum of 580 square kilometers was ordered by the Director General Mr. Yosuf Alehaidib. Initial maps

obtained were prepared on the basis of 1964 aero-photographs at scales of 1/20000, 1/10000, and 1/5000 and prints of the 1964 aero-panoramic prepared by Fairey Surveys Ltd. taken in December 1964. Riyadh city air photos were provided by the Columbus co. at scale 1:20,000 taken in spring 1966 and air photo blow-ups from the Hausa Luft co. taken December 1967, to inform mapping and urban growth projection analysis. The project team conducted visual surveys throughout areas of the city.

The Technical Department of the Ministry of Finance located Royal Decree's determining the use of land and provided this document to Doxiadis Associates. The Town Planning office of the Ministry of Interior for Municipalities had updated an existing land use survey in the spring of 1968 which established a generalized land use survey prior to the start of the master plan commission. Cansult, a Canadian consulting firm, was in the process of designing the sewerage system of the city. Water Resources of Riyadh were analyzed in relation to the future development of the city and was submitted to the Deputy Minister of Interior for Municipalities. The scope of the Master Plan did not include strategic planning for water, as it was under the authority of the Department of Water Resources of the Ministry of Agriculture by Royal Decree.

Approximately one month after opening the Riyadh office the scope of work was increased to evaluate the location of the Athletic Centre, a project commissioned to Kenzo Tange; and to evaluate the impact of the current airport site and its probable removal with a very short feasibility report; and prepare design proposals for the redevelopment of the old city centre to include specific suggestions for the preservation of the distinctive old fabric of Riyadh. The Ministry of Interior also requested Doxiadis Associates evaluate suburban site locations for the installation of approx. 7000 families

(civil servants, employees, shop-keepers, tradesmen) of low and middle income groups (Doxiadis Associates, R-SAU-RD 15, 1968).

4.5 The First Master Plan for Riyadh 1972

Doxiadis' vision of Riyadh in the year 2000 was for a capital city to be the main administrative, cultural and educational centre of Saudi Arabia, projected to have a population of 1,400,000 and be in the order of a Community Class VII with the metropolitan area extending over 30,400 hectares. The visual signature of the city was envisioned by Doxiadis to be the city skyline curve, which gradually rises towards the central areas and tapers to the peripheral edges, surrounded by cultural and recreational spaces (Doxiadis Assoc. DOX SAU A6, 1969). Doxiadis determined the main axis of the city to be King Saud (Batha) Avenue with a secondary series of east west roads such as New Dira Road, Khazan Street and Assir Street to the south to form the integrating vehicular structure of the city (Doxiadis Assoc. DOX SAU A37, 1973).

The examination of the problems as well as discussions with the authorities led Doxiadis to draft ten decisions which covered the most pressing points related to the city's function and development. Water was excluded as it was under the authority of the Department of Water Resources of the Ministry of Agriculture by Royal Decree. Numerous Saudi Arabian officials and consultants were involved in guiding efforts to undertake the Survey of Existing Conditions and evaluate scenarios for the final master plan. One problem of the city of Riyadh in Doxiadis' view was that the city's existing spatial form did not provide an area adequate to accommodate the city's national administrative functions – which would be worthy of its significance and symbolic nature. Government Ministries were distributed along Mataar Road and areas south of

Murabaa and west of Shamsiya. The Doxiadis master plan report stressed the need to define an area for national administration to establish state and national prestige, symbolizing principles of unity and strength (Doxiadis Associates, Dox-SAU-A19, 1968).

Doxiadis established the ten decisions and their corresponding cost specific to the implementation of the master plan as:

- | | |
|---|-------------------|
| 1. Construction or improvement of 195 km of major roads and arteries | S.R.120.0 million |
| 2. Provision of new plots and dwelling units for 10,000 families
and of the corresponding community buildings. (typical residential communities) | S.R.230.0 million |
| 3. Amelioration of 4,000 dwelling units in the old parts of the city. | S.R. 9.0 million |
| 4. Development of 20 hectares of land for civic and commercial functions | S.R. 9.0 million |
| 5. Development of 125 hectares of industrial land. | S.R. 23.0 million |
| 6. Restoration and rehabilitation of Diraiya | S.R. 4.0 million |
| 7. New development in Justice Square (dira) and areas for detailed design. | S.R. 50.0 million |
| 8. Legal adoption of the Master Plan for the Development of the City of Riyadh by Law. | |
| 9. Promulgation of law concerning expropriation and reallocation of land. | |
| 10. Promulgation of taxation concerning undeveloped land and betterment areas. | |

The Doxiadis master plan imposed a strict super grid structure on the city, establishing a single direction of expansion to the north west, which radically transformed the existing urban spatial form of Riyadh. The Doxiadis spatial framework concentrates urban development in a single linear spine and establishes connections between the new and existing settlement. The super grid of 2 km x 2 km blocks redefines the existing spatial form of the city, integrating local and macro spatial scales and forming a hierarchy of cascading transportation structures to define the urban territory.

At the macro urban scale the existing airport location was considered to a significant structure impacting the city's future urban expansion. Alternatives to retain and relocate the airport were presented in the final master plan scheme. The decision to

retain the airport in its present location for a period of 10-15 years was reached by the highest Committee of the Government. The design of the master plan allowed for the proper incorporation of the area now occupied by the Airport within the body of the city (C-SAU-A519, 1969).

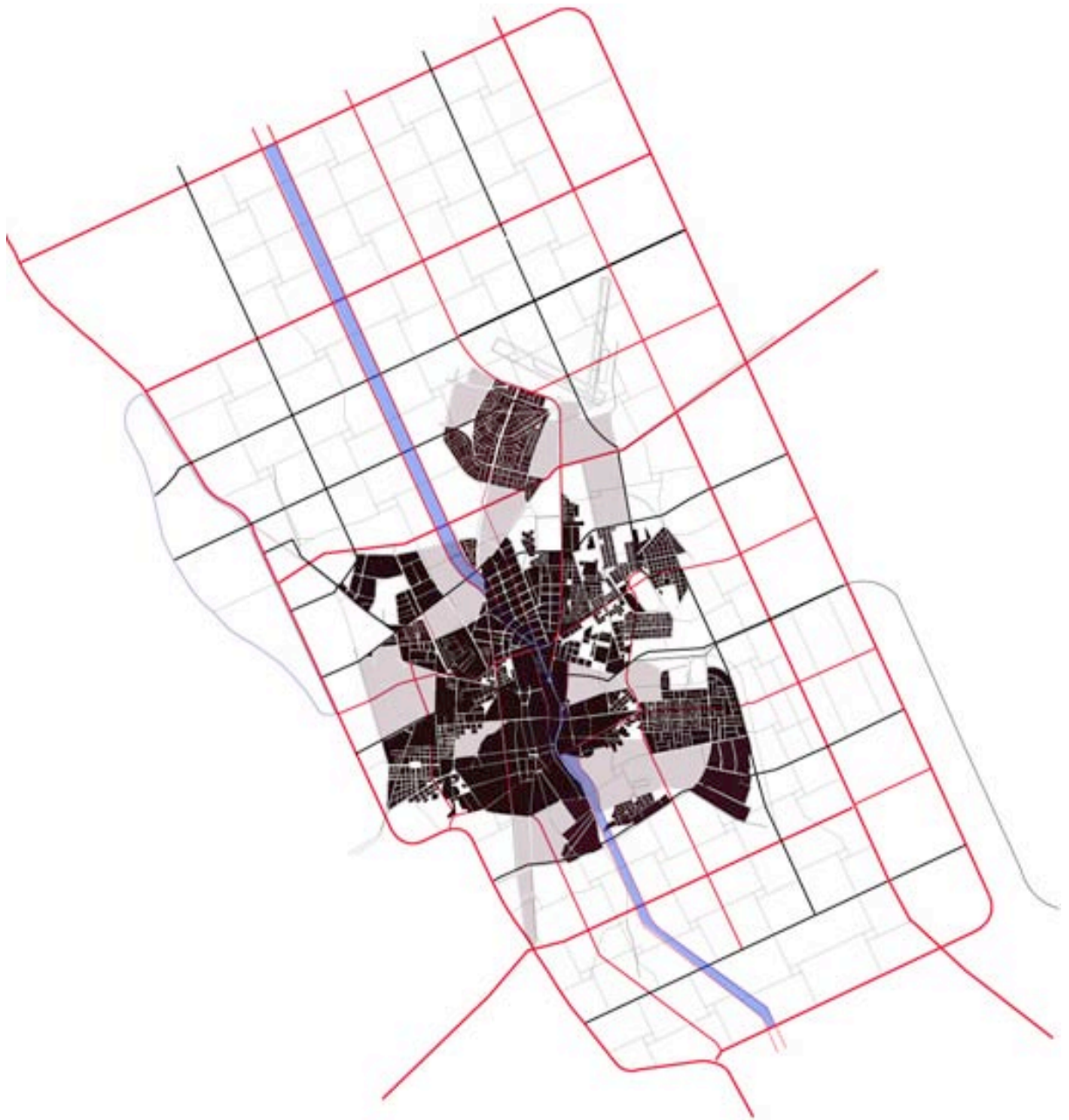


Figure 27 Doxiadis Master Plan With Riyadh's' 1968 Urban Extents

A number of alternative schemes for the master plan were based on the spatial form of the city under immediate conditions of growth and its ability to structure and accommodate future expansion. These urban designs proposals are based on the general evaluation of the site context, and aim to best direct urban expansion. Evaluations concentrated on a number of positive and negative physical conditions which required analysis to determine the direction for Riyadh's future growth. These included the suitability of topography in the various zones and the general morphology of the land, manmade obstacles; subsoil conditions; the natural settings scenic attractiveness; its proximity to green areas, natural water courses and fit with micro-climatic conditions. Alternative No. 4 Expansion North-West (also noted as No. 7 in Figure 28) was selected to be the underlying master planning concept. Upon selecting Alternative No. 4,(No.7) two scenario plans were further developed, one to retain the existing airport in its current location and a second plan showing the airport relocation further outside of the city limits.

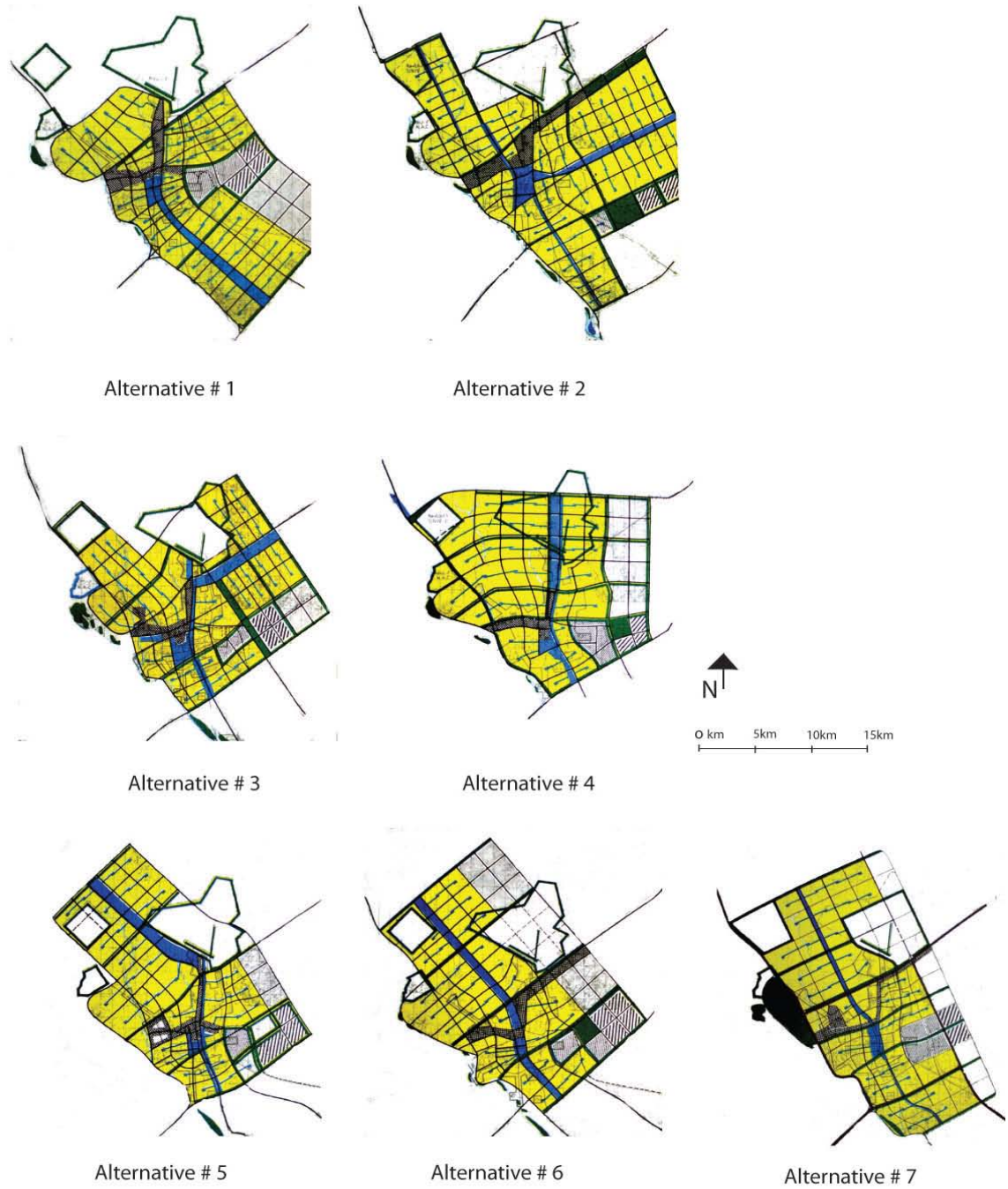


Figure 28 Alternative Urban Structural Strategies, Doxiadis Associates 1969

4.5.1 Strategic Organization of Territory: Macro-Structure

The Master Plan organization divides Riyadh's urban area into three zones, the *Action Area*, the *Master Plan Area*, and the *Controlled Development Area*. The Action Area boundaries encompass an area of approximately 11.2 square kilometers covering three existing districts of the city. Subdivision legislation focused on density, building heights and minimum lot sizes to control residential development in the *Master Plan Area*. The *Controlled Development Area* was regulated loosely by a set of land use controls which allowed the construction of community facilities and residential or public building of not less than 200 square meters on plots of not less than one hectare.

Originating from the existing central business district the northern axis was established as the cities development spine, which would accommodate the progressive expansion of urban centers. The northern orientation of the urban structure was perceived to best avoid direct east and or west solar radiation, and reduce sand storm exposure while aiming to capture the predominant north and occasional south-southeast breeze (Doxiadis Associates, DOX SAU A2, 1968). Urban development and density was to be distributed throughout the urban structure. The 2 km x 2 km grid-iron framework of blocks (the modulus) is orientated to align with the main axis of the master plan N-NW to W – SW, spatially organizes the urban territory. The grid-iron framework is inscribed by a hierarchical transportation network which divides the city into five major districts or integral townships allowing for the decentralization of functions. The concept of a highly concentrated urban center was replaced by the spatial zone of the activity spine shown in blue in Figure 29.

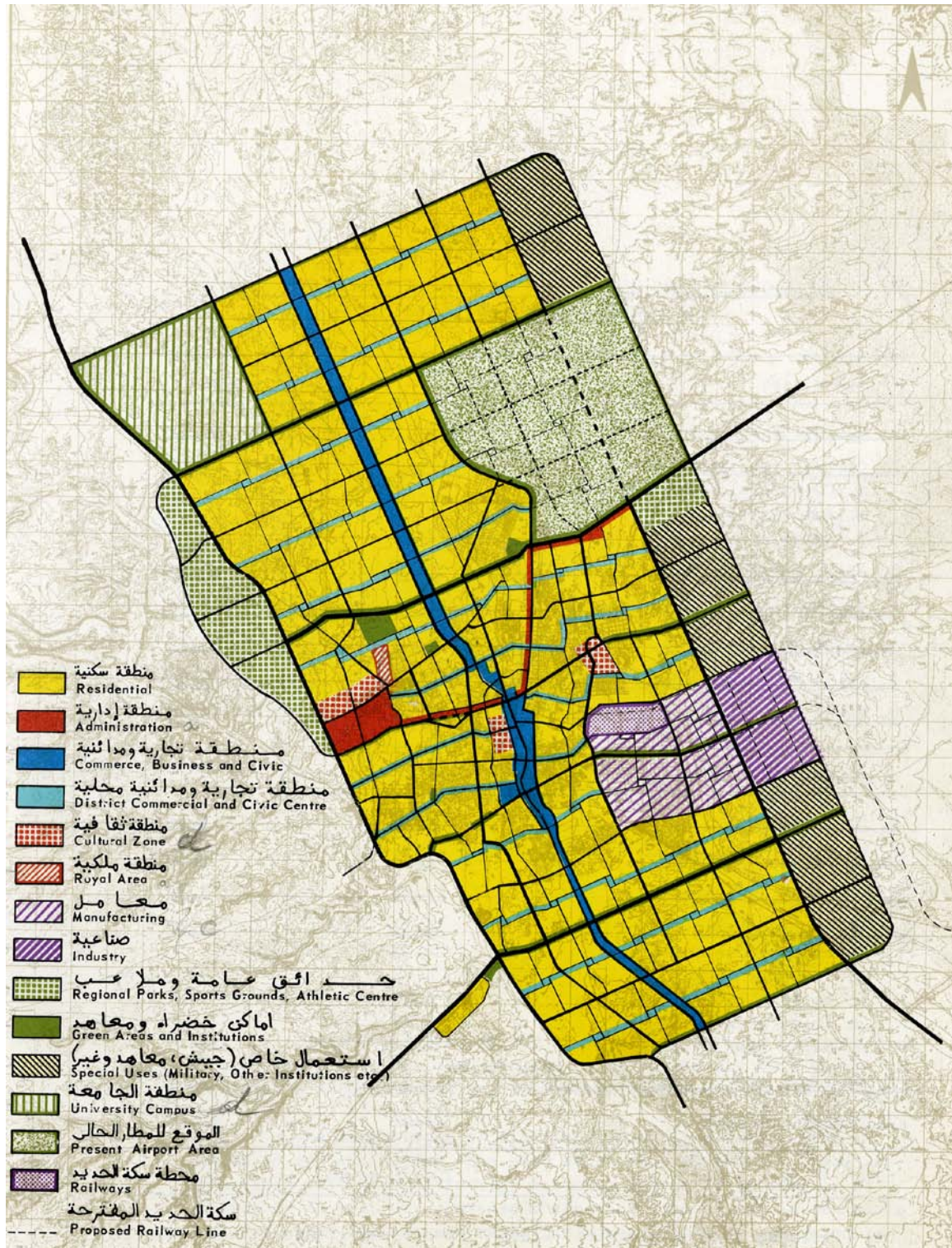


Figure 29 Urban Structure of the First Strategic Master Plan Riyadh, 1972, Doxiadis Associates

4.5.2 Action Area Connection Strategy

The spatial transition between existing and new urban structure was articulated in the Action Area strategy developed by Doxiadis. This is a significant component of the first strategic master plan and reflects progressive connection between the historic center with the new spatial framework of the 2 km x 2 km grid. Doxiadis considered the concentration of urban function and density on the central spine as a critical component for sustainable and healthy growth of a settlement as this strategy shifted urban growth and density to new urban centers beyond the existing central business district. The aim of the Action Area detailed plans was to integrate new and old urban fabrics by establishing the formation of the new activity spine which was to replace the existing central business district as a key attractor for future development. It also devises a strategy to transition the spatial form and structure of the existing city to align with the new 2 km x 2 km grid, and clearly establishes the separation of automobile and pedestrian movement.

The spatial strategy developed by Doxiadis was implemented within the Riyadh project specific to the cutting of roads and territorial divisions within the existing spatial fabric of the existing city. The transition strategy anticipates that a more intense and concentrated development would occur along the spinal axis of the action area in order to meet the expansion of social civic and commercial services. Importantly the Action Area is adjacent to the central business district and constitutes the fabric adjacent to the linear axial spine of the new urban structure plan. Zoning plans establish the intensity of future developments for the area with the transitional urban fabric from older to newer developments located to the north of the existing center, concentrating mainly business and commercial functions (Doxiadis Associates, DOX SAU A37, 1973). This area is

identified by Thahirah, Alouse and Sweilem Streets from Murabaa to the north of Justice square to the south. The second area lies between Bathe and Malek Faisel Street.

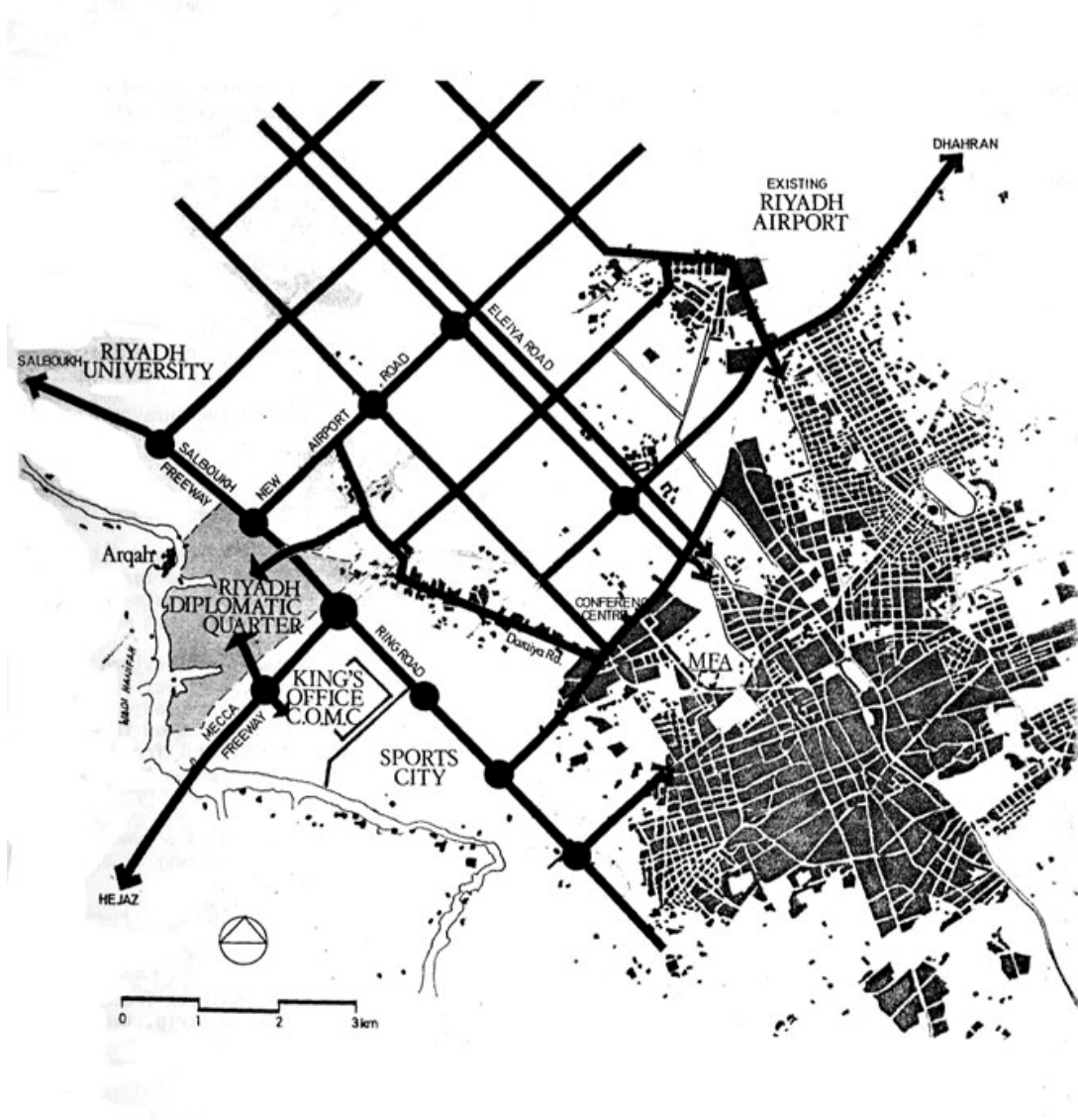


Figure 30 Road Connections Doxiadis Grid, Diplomatic Quarter and the 1968 City of Riyadh



Figure 31 Transition Area Detailed Designs, Doxiadis Associates, © Middleton, 2008

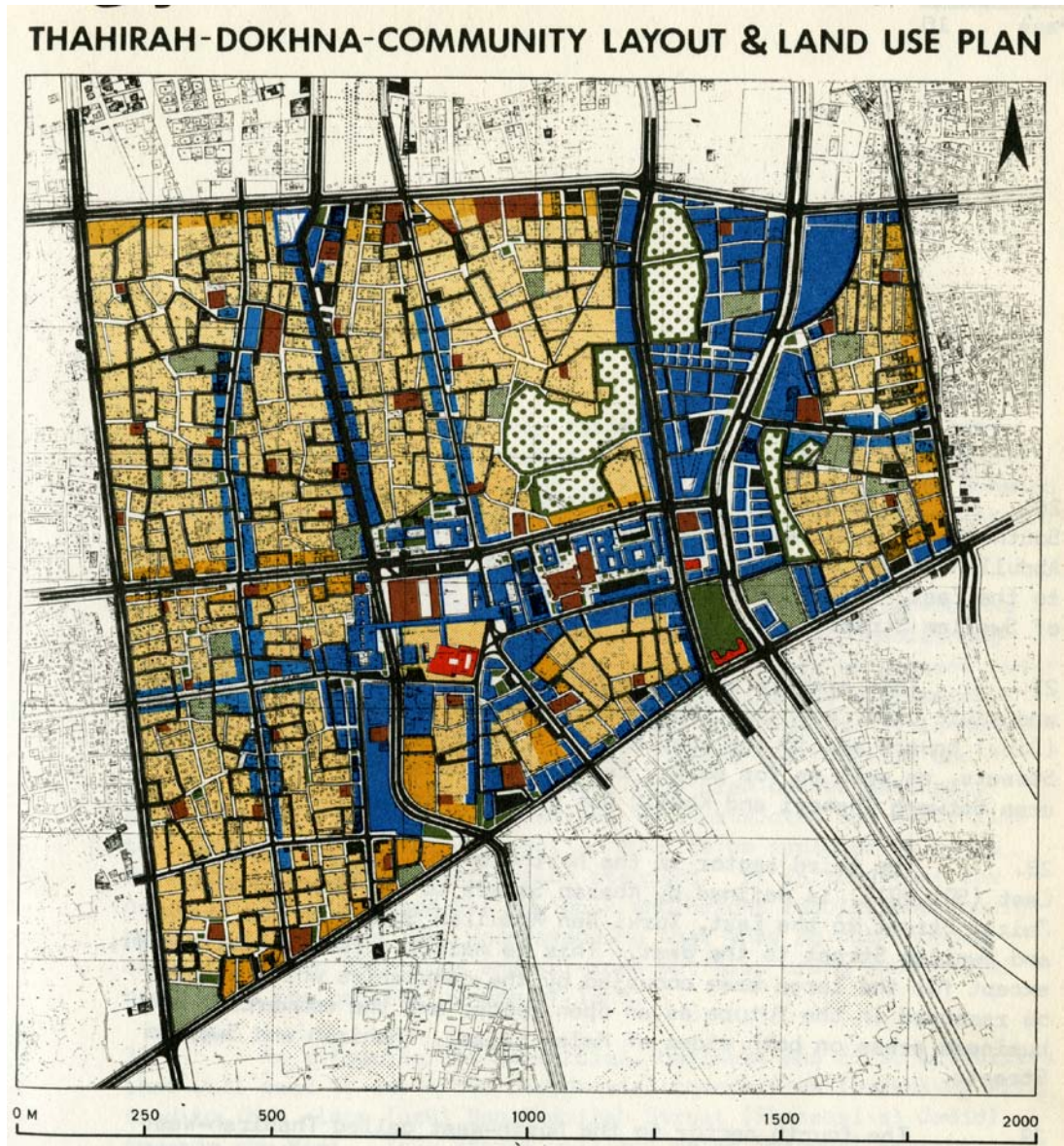


Figure 32 Detailed Design for Thahirah Dokhna 1972 © Doxiadis Archives

The future population of the Action Area was estimated to be 200,000 – 300,000 persons (Doxiadis Associates, DOX SAU A37 April 1973). The Action Areas shown in Figure 31 and Figure 32 were designed in detail upon specification by Saudi Arabia Officials and Doxiadis. These areas concentrated most of the 1968 development pressures of the city and distinguished pedestrian and vehicle distributions. Identified as

the first priority areas, the total surface area of the transition zone covers 16,760 square kilometers, of these 5,804 square kilometers are built-up, whilst 10,956 square kilometers are on open ground. The detailed design for separation of pedestrian and automobiles was also introduced within the historic areas of the city center as shown in Figure 32 (black and white road designations) and are important for the formation of contemporary urban design strategies for these areas. Significantly this Action Area Strategy was implemented and the Doxiadis design structure is strongly evident today.

Table 2 below reflects the current context of these areas.

Table 2 First Priority Areas for Detailed Design and Implementation, Doxiadis Associates, 1969

Area No.	Surface sq. km.	Built-up	Surface Built-up	Open Ground
1	2.500	25%	0.625	1.875
2	3.600	-	-	3.600
3	4.920	20%	0.984	3.936
4	3.530	75%	2.648	0.882
5	2.210	30%	1.547	0.663
	16.760	-	5.804	10.956

The division of the urban territory follows the ideal spatial hierarchy of Community Classes (Figure 33) as proposed by Ekistics theory. Plot sizes range from a minimum of 150 square meters to an average maximum of 1,500 square meters. This structure was perceived to avoid direct east and or west solar radiation, and reduce sand storm exposure while aiming to capture the predominant north and occasional south – southeast breeze. The residential districts of the city were located in close proximity to the central spine with the urban structure bounded on the east by light industry, the airport, and other functions, creating a buffer inhibiting future expansion.

تركيب الأحياء STRUCTURE OF COMMUNITIES

FIG 10

296

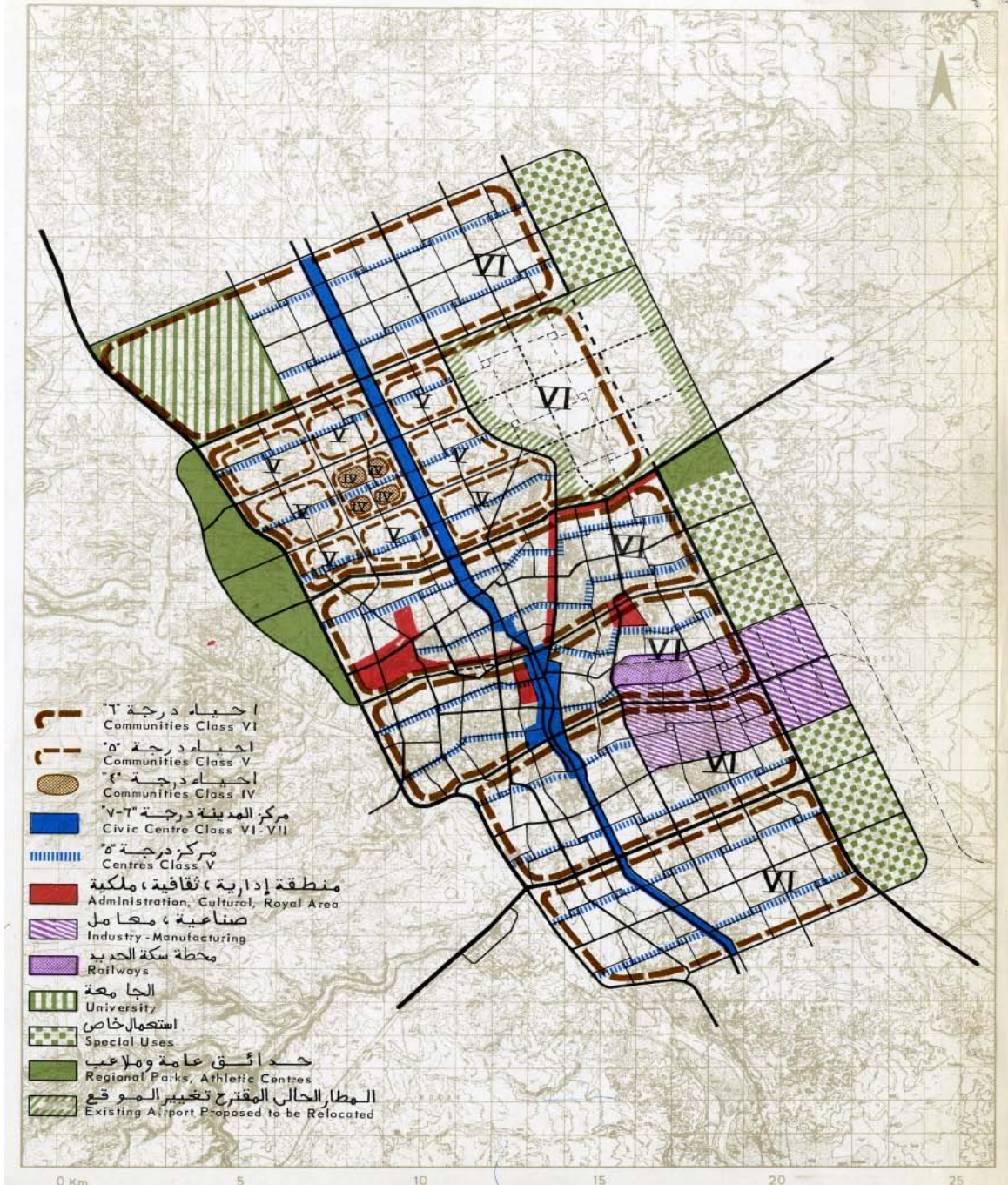


Figure 33 Organization of Territory by Community Classes, 1972, Doxiadis Associates

The organization of urban functions is placed at right angles to the north-south central axis, establishing a zone of National Administration to run from the Royal area on the edge of Wadi Hanifa in the North-West to the new airport in the northeast. This area was to house Ministries and Government Agencies. Cultural areas are situated to the west of the Murabaa-Futah Royal area and the present race course located near Al Malaz. The old city will extend over part of three of these. It is understood that within these zones residential accommodation will be allowed by means of apartment buildings.

The existing city of Riyadh was considered to be a Community Class VI based on its population and was projected to be a Community Class VII consisting of six, communities classes VI by the year 2000. The six Community Class VI district are defined by boundaries of high volume highways and spatially organized to sequentially stack in a northern orientation, centered on the activity spine which can be discerned in Figure 34. Each Class VI community will focus on the zone of central functions of the city and will comprise eight-twelve Communities Class V moduli, further subdivided into four to six Communities Class IV units.

Community Class V referred to as the Modulus or as the 2 km x 2 km grid-iron framework of blocks which establishes a unified spatial pattern to the city. The modulus unit accommodates 50,000 residents, is aligned perpendicular to the axial activity spine, and through a process of continuous aggregation spatially organizes the urban territory in a north-northwest to west- southwest orientation. Each Community Class scale was established with its own internal structuring and zones of civic and commercial functions of lower order with secondary schools located on the periphery of the larger residential

blocks. Summary of the Community Class hierarchy with associated functions (see Appendix B) outlines the application of Ekistic spatial scales for the Riyadh master plan.

4.5.3 Transportation Structure

The Transportation structural plan for Riyadh was presented February 1969 within the framework of the preliminary development plan of the city to the year 2000. It was envisioned to serve an area of 30,400 hectares and a population of 1,400,000 inhabitants. It was incorporated in the final development plan of the city of Riyadh and constitutes the long-term framework within which the design of the various specific projects are coordinated and implemented.

The main road network was initially determined on the basis of the land use proposal in the master plan and the expected population distribution. A regularized road network overlay integrates the existing road structure of Riyadh and it's the principle existing north-south, east-west road arteries. In the area of the existing city a deformed grid is established to respect the city's existing major roads and to minimize expropriation costs. The road pattern in the development area of the city continues to be slightly irregular although proper hierarchical classification and connections were made to conform to the expected travel flows and to achieve a balanced distribution of traffic. The tracing of new streets within the old city was to be inscribed around the existing neighborhood units identified in the analysis of the existing structure of Riyadh.

A new freeway establishes the connective membrane binding a regularized extension of arterial roads into the formation of a super-grid. Four freeways encompass the existing city, connecting it at the four main exits towards Dammam, Kharz, Hejaz, and Solbukh. The inter-urban traffic from Dammam to the Hejaz and Dammam to Kharz

would avoid the city via a new inter-urban transportation link and by-pass road, which is to be constructed on the limits of the area surrounding the city.

The existing highway to Dammam is strongly evident in the road network strategy shown in Figure 34. Two, north-northwest to south-southeast and three, west-southwest to east-northeast expressways complete the high speed, long distance network by-passing Riyadh and the central business district (Doxiadis Assoc. DOX SAU A6, 1969). The main road network has a total length of 457.8 square kilometers distribute to flow among the various classes of facilities. The grid-iron configuration of the transportation network avoids the convergence of movement to one or more focal points. The balanced distribution of functions, and the rational network conception, results in an average trip length of 8.5 minutes or 6.1 kilometers corresponding to an average speed of 2.8 kilometers per hour. The transportation design is significant in establishing an aggressive estimate for the city's future traffic volume projections with proposal for the classification and dimensioning of the main road network constituting a long-term framework (see Appendix B for a detail examination of the Riyadh road hierarchy). At the local scale the road structure within the modulus was organized to establish an intimate organizational hierarchy. Traffic calming strategies were incorporated into the design through the avoidance of through traffic rights of way through the district. Typical road widths guidelines were established for all new, proposed and existing communities such as the South Elyia community, designating green areas, pedestrian paths, parking and road ways.

تسلسل شبكة الطرق الرئيسية
HIERARCHY OF MAIN ROAD NETWORK

FIG. 34

487



Figure 34 First Master Plan Road Network Hierarchy, Doxiadis Associates 1972

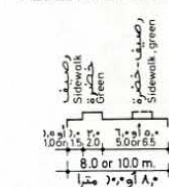
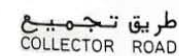
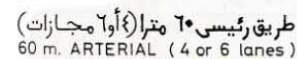
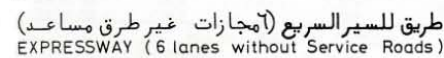
Highway design concerns during this period focused on the horizontal alignment in relation to variations in topography for each carriageway, the skilful adaptation of the profile. The entire cross-section may be treated to maintain parallelism, concentricity, and unvarying cross-sections for the entire highway. The general approach to design during the Post-War period specified that the width of traffic lanes should vary with the amount and type of traffic. Rather than conforming to the requirements of the topography factors such as general alignment, sight distance, vertical curves, design speed and class of highway governed design decisions. A twelve feet lane width was recommended as standard for new construction or for the reconstruction of existing facilities during this period.



Figure 35 Aerial Photograph of the Central Axis of Riyadh © MEDSTAR 2008

303 FIG. 1

طريق حر
FREEWAY



D-SAU-A30010/333

صاحب: شوکت علی - مکتبہ دارون فی ساریں الشریعہ والاقتصادی

114

4.5.4 Strategic Organization of Territory: Local Structure

The interior division of the 2 km x 2 km Modulus follows a spatial hierarchy of Community Classes which accommodate a range in plot sizes from a minimum of 150 square meters to an average maximum of 1, 500 square meters. Both new and existing residential areas and their associated services and functions were ordered according to the Ekistics Community Classes considered as an imperative to establish optimum range of functions from economic and social points of view. Urban functions and services areas are situated at right angles to the north-south central axis which establishes the dominant location of administrative, commercial functions of the city.

The modulus is composed of three well defined parts, the car-traffic section, the car parking section and the section for human beings. Car-traffic section was located on the boundary of the sector formed as the hardest and most rigid part of the sector, physically and functionally, the sector is bounded by the highway. A system of densities based on units grids of space specific to settlement type governed by a proportional rule where higher densities of residence and functions require higher densities of transportation and all types of utility networks. The interior of the sector is envisioned as human centric and pedestrian movement establishing a ½ mile or ten minutes walk from the furthest point to the center. Corresponding functions are spatially organized in tandem with Ekistic scale of community classes (See Appendix B, which establishes the community class logic for Riyadh with breakdown of functions distributed according to inner and outer service area limits).

The spatial urban pattern is defined by a repetitive aggregation of moduli stylistically absent of distinctive character or identity. The perimeter edge of the modulus is zoned for commercial and service functions which line the street. The massing of the

urban fabric pattern is characterized by a compact building system, where building heights except in special cases vary from eight storey's in the center of the city, to four storey's along the principal civic and commercial zones of the northern axis of the city to three storey's in areas adjacent to the principle civic commercial and administrative zones and one-two storey's in the less dense areas that lie on the outskirts of the central business district.

The internal road hierarchy did establish bounding edges to define spatial structure for the spine, modulus super block, and the framework of community classes. The constitution of commercial, civic, and public centers are not clearly defined if at all with the functional program hierarchy of community classes and associated functions were not established in detailed design schemes. The dominant design strategy was to establish the separation of pedestrian and automobile traffic and define strong spatial units. The moduli throughout Riyadh are tightly bounded by the master road structure establishing the dominance of a few access and exit point to the modulus which constitutes a small city area in its own right. The aggregation of super blocks occurs in tandem with the construction of road and service infrastructure according to the growth phasing strategy (Figure 41).

The analysis of existing city structure at the local scale reveals the extensive variety of community layouts which has developed across the city. Across all moduli the strong articulation of imbedded spatial definition of Community Class IV and III neighborhoods is apparent. There is no evidence of a separation between automobile and pedestrian rights of way through these communities as sidewalks and green spaces were not developed as per the master plan. The lack of open space and clear avoidance to

establish recreational areas within Community Class V is a serious omission that was frequently under discussion by Saudi Arabian officials who repeatedly requested the development of detailed landscape designs. These were never prepared by Doxiadis Associates, who considered the expense associated with the development of open areas to be secondary to the first order priority to establish road and infrastructure networks of the city (Doxiadis Associates, 1971).

The examination of the Modulus N13-N14-E01-E02 establishes a strong nested pattern of streets and subdivision of territory. Multiple centers are evident as a spatial pattern but have failed to materialize in the architectural development. Further no evidence of connectivity across spatial areas is to be found, the repetitive and rotated nature of the community with internal streets bounded by high walls of residential private property establishes poor internal legibility and way-finding within the community. The design strategy was intended to limit through traffic which has resulted in poor center formation with commercial areas forming along the peripheral edge of the Modulus.

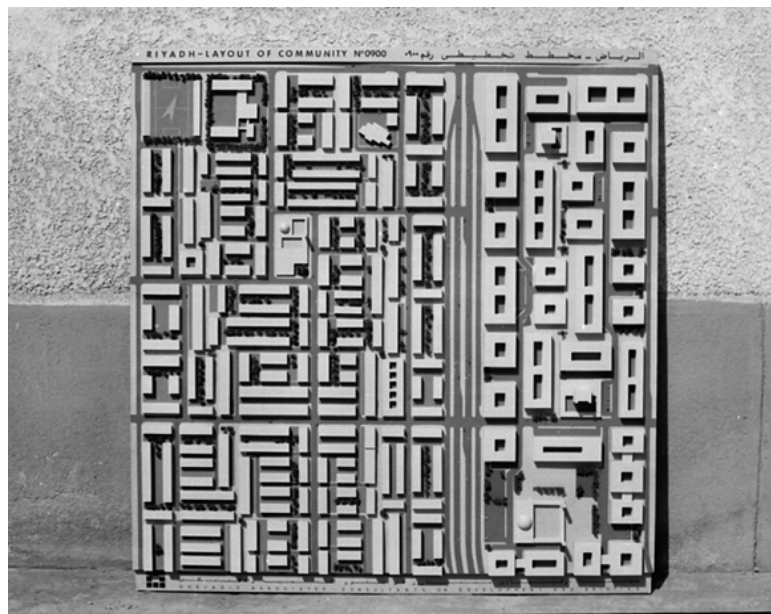


Figure 37 Riyadh Conceptual Model of a Community, Doxiadis Associates 1969

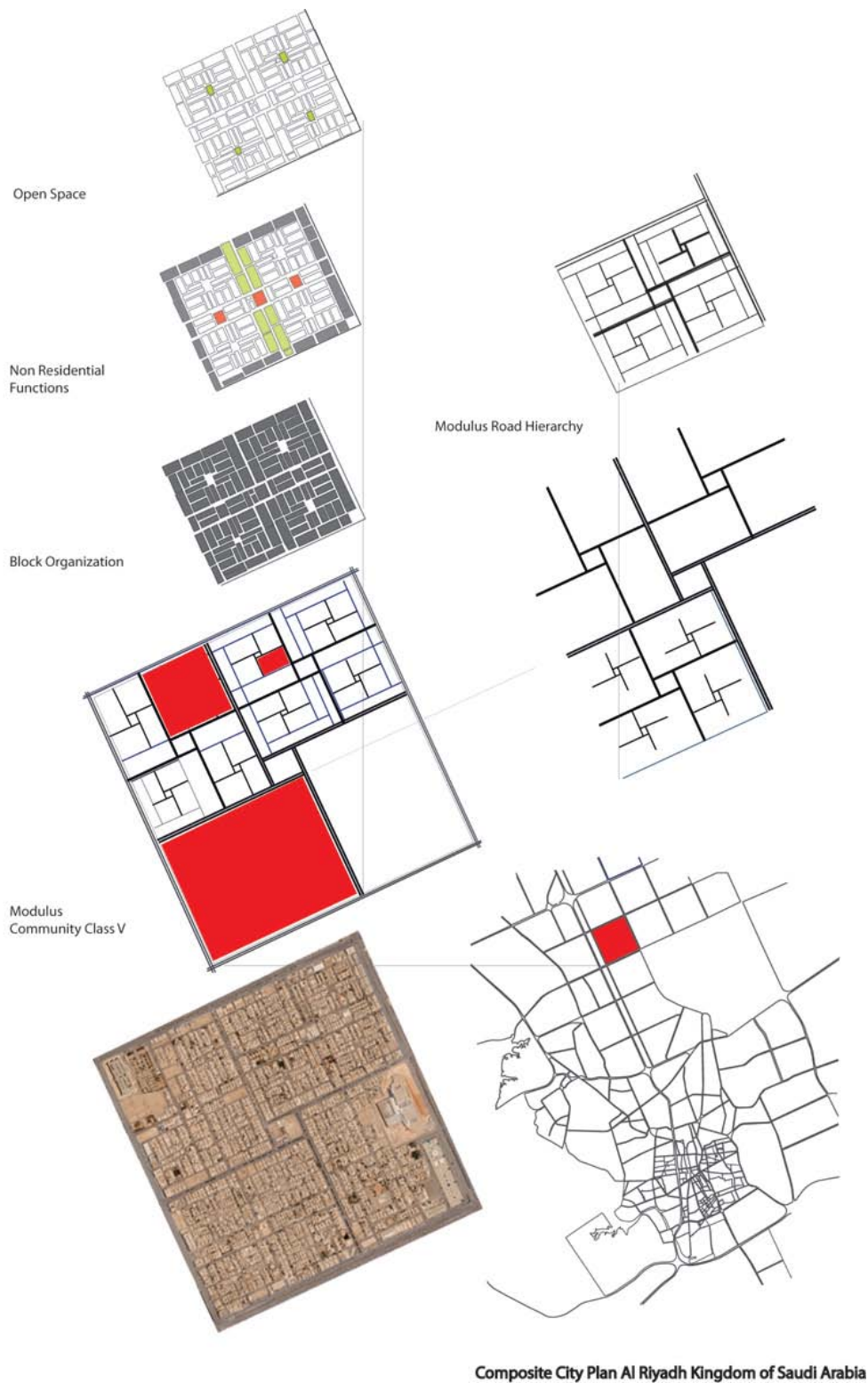


Figure 38 Spatial Hierarchy Variations in 2km x 2km Modulus, N13-N14 E01–N13-N14E02 Riyadh

The first master plan outlined a compact urban area of 304 square kilometers, of which 150 square kilometers was allocated for residential development to accommodate a population of 760,000 to the year 1985, and 1.4 million to the year 2000. These area extent projections for the city were established in tandem with population densities at three levels, 40 person/ha, 60 person/ha, and 80 person/ha spread across three areas within the total of 304 square kilometers of urban extents. The overall urban density for Riyadh was to be 60 persons per hectare, with a net residential density of 200 persons per hectare as established by Doxiadis. The distribution of density would concentrate near the central spine of the city and taper to lower densities towards the peripheral urban edge. In comparison the city of London had an overall density of 85 per hectare, Tokyo 152 per hectare and Athens 170 per hectare.

The Doxiadis zoning system establishes three development approaches. The first is a traditional attached system zone with buildings containing a central courtyard, second is a zone reflecting contemporary attached row system of buildings, and third is a zone of mixed attached and detached systems. The existing typical building heights in the city was two-three storey's influenced by traditional ways of life and architecture. The master plan recommends that building heights except in special cases be limited to eight storey's in the center of the city, four storey's along the principal civic and commercial zones that constitute the main axis of the city from north to south and three storey's in areas adjacent to the principle civic commercial and administrative zones, and one-two storey's in the less dense areas that lie on the outskirts of the central business district.

SOUTH ELIYA COMMUNITY-ZONING PLAN



Figure 39 Doxiadis New Zoning Strategy for Action Area

Land use was classified as residential areas, royal areas, commerce and business, industrial and manufacturing, national and administrative, educational areas, health services, religious, monumental buildings, sports fields, public gardens, cemeteries, airport and major roads. Riyadh's infrastructure was conceptually and operationally

designed according to a supply and demand paradigm of service management which has dominated the organization of infrastructure and urban territory.

‘The Doxiadis master plan confirmed the existing zoning and building height regulations, in some cases continuing what existed before, such as the setback requirements, while in other cases preserving the concept but proposing different standards, and therefore introducing a new value system of minimum lot size’ (Al-Hathloul, 1981). The confirmation of setbacks and the introduction of different standards for minimum lot sizes in different areas of the city had a major impact on the development of Riyadh in the 1970’s. Zoning ordinances regulating the future development of the city established detailed zoning by-laws and plans, subdivision legislation and loosely regulated set of land use controls. The master plan preserved this concept of minimum lot size however, instead of proposing one standard size for the whole city; it proposed different standards for different areas (Al-Hathloul, 1981).

The overall gross residential density of the city (including the special use zone, national university, manufacturing, regional parks, etc.) that will be reached at the year 2000, under the assumption that all residential areas will be built and used to the full capacity permitted by the zoning regulations is 46 inh./hectare. Excluding special zones and areas gross density will be approximately 70 inh./hectare (Doxiadis Associates, Dox-Sau-A19,1972).

Doxiadis viewed the original center of the city to be Justice Square and considerations were made specific to the historical importance of the area, and its monumental character in connecting past with future, religion and government, culture and development. The strategy to address the traditional environment in the city center

was expressly, “to retain the traditional architecture of the surroundings, accommodating its present uses, and provide for the possibilities of big public gatherings. At the same time the opening of new perspectives enhanced considerably the appearance of such monumental buildings as the big mosque and the great fort of Maskmak. The typical rough rectangular pattern of streets, converge visually in each neighborhood towards a small open space or square in the front of the local mosque.”

To enable growth to occur a strategy for comprehensive developments on bigger plots was established to allow for reasonable increases in the density of habitation in the area. “It is suggested that whenever possible, and more so in the commercial and civic area whole blocks or sections of communities, could be designed as one complex, in order to provide for the required elements of a unified design although the use may be multipurpose such composite features, cannot be really achieved by an independent design on each plot.

4.6 Saudi Arabian Influence on the Master Plan

Three official meetings were held at the head office of Doxiadis Associates in Athens, Greece, July 28 - August 4, 1969 to discuss the preliminary Master Plan. Sheikh Abdullah Sudairy, Deputy Minister of Interior for Municipalities, Dr. Azzam, Mr. Saud Lingawi, and Mr. Rassem Shaeth, attended from Saudi Arabia. The main focus of these meetings was to examine the master plan and address evaluative comments made by the various Saudi Arabian Ministries. Comments specific to the preliminary master plan focused on population size, the dynamic structure of the plan, flexibility for future expansion, allowing for physical development by stages according to the economic and population potential of the capital wither within the frame of the proposed plan, or even

beyond. The Lord Mayor of Riyadh Thanayen, Mr. Rassem Shaath, Dr. Azzam, pointed out that although the plan prefers development of the city towards the north-northwest, roughly parallel to Wadi Hanifa, commitments had already been made in other directions, mainly towards Khurais and Hejaz roads, that should be also taken into consideration and shown in the Structural Plan.



Figure 40 Meeting to Discuss the Preliminary Master Plan, Saudi Officials and C. A. Doxiadis in Athens July 28-Aug 4, 1969

Debate concentrated on the feasibility of housing projects aiming for the provision of 10,000 houses of lower-middle to lower incomes in support of the National Development Program: Royal Decree No. 23/M, 1974.

“It was assessed that the physical plan of the city, as prepared and structured, can accommodate without damage to its structure and workability, a fluctuating size of population in the various target years and development stages that are being considered. It was agreed furthermore that the needs in community services and buildings, as well as dimensions such as industrial areas, administrative area, number of workers, number of civil servants and other component factors, should preferably be estimated on the basis of the average population size as shown in the projections of the Consultant.”

Doxiadis Associates, 1969 (C-SAU-A519)

Doxiadis Associates was subsequently commissioned to develop a housing program for Saudi Arabia, with the mandate to develop standard typical houses. Doxiadis applied the housing typical plans developed for the Bagdad Iraq master plan directly without revision to the Saudi Arabian context. Correspondence between Saudi officials and Doxiadis specific to detailed planning of the Action Areas and Modulus neighborhoods also reveals an emerging tension between the client and architect/urban designer. Saudi Arabian officials increasingly were frustrated over concerns that the revised report on street improvements and beautification made no mention of landscaping, green spaces or parks. Doxiadis replied to their repeated requests for additional emphasis and consideration of natural areas in the city by making reference to the need for “more hard type landscaping instead of softer green elements” and clarifying the approach to greening the city as follows;

“The Consultants wish to clarify that the committee must be very careful with the exact extent of the work provided by the agreement, as any claim for works over and above the scope of this agreement may deprive the cities of more essential street construction. Taking into consideration that the proposed funds are limited the amounts specified in the relevant clauses. The consultants shall be happy to provide for the creation of public parks, recreational areas and playgrounds, but only in case that such works can be justified by the immediate and urgent needs of the cities during the five year program, by relevant allocation of an approved master plan, and if, of course, additional funds are required.” Landscape and beautification requirements are envisioned to concern, “Landscaping adjacent to the street network, main beautification features and minor improvements were required of all streets and street intersections.

Arriyadh Community Layouts Supplemental Report Dec. 1972
(Dox SSAU A 35-37, 39, 40 1973)

The examination of the problems as well as discussions with the authorities concerned, led Doxiadis to draft ten decisions which cover the most pressing points

related to the city's function and development. Water was excluded as it was under the authority of the Department of Water resources of the Ministry of Agriculture by Royal Decree.

A final presentation of the proposed master plan for Riyadh was made by C. A. Doxiadis to

Throughout the master plan there is a glaring omission of a development focus on identity formation, and social and public places for the city, and the formation of a spatial capital image and identity. There is no consideration of familial social life within the design strategies, which may reflect preconceptions of the society or an absence of knowledge specific to the social and cultural context of Saudi Arabian life. The absence of designs for open spaces and pedestrian oriented recreation areas has had long-lasting repercussions on the capital city and its residents.

4.7 Urban Expansion and Transformation Strategies

Discussions between Saudi Arabian officials and Doxiadis specific to the review of the preliminary master plan, held in Athens Greece from July 28th to August 4th, 1969, highlight concerns specific to the phasing of development outlined in the master plan and its ability to accommodate future expansion. Population projections within the master plan were considered by both the Ministry of Finance and the Central Statistical Department of Saudi Arabia to be 'somewhat conservative'. Saudi Arabian estimates projected an annual population increase of 11 percent for the present and accepting a decrease in the population rate of growth in the next 20 – 30 years, estimated the population to reach the level of 2 million people in the year 2000 AD. Discussions on

the variation in population projections concluded that ‘the base structure of the Master Plan as proposed, is dynamic and allows for a physical development by stages according to the economic and population potential of the capital either within the frame of the proposed plan, or even beyond’. Point 12 in the meeting minutes(C-SAU-A519, page 4) states;

‘Following some discussion on the matter, it was assessed that at the physical plan of the city, as prepared and structured, can accommodate without damage to its structure and workability, a fluctuating size of population in the various target years and development stages that are being considered. It was agreed furthermore that the needs in community services and buildings, as well as dimensions such as industrial area, administrative areas, number of workers, number of civil servants and other important functions, should preferably be estimated on the basis of the average population size as shown in the projections of the consultants.’

A review of meeting minutes reveals the Doxiadis strategy aligned the process of development to the budget limitation of the city and its need to address the acute and immediate problems. Development works were to gradually extend in phases to cover the needs of the growing city incrementally in 5, 10, 15, 10 years. The Saudi Arabian Officials led by Dr. Azzam stressed the need for a detailed growth strategy to clarify the steps of development (C-SAU-A 519-5, 1969).

The growth of the city was established by the Final Master Plan,1972 to occur in three phases; First phase 1970-1975, Second Phase 1975-1980, Third phase 1980-2000 as shown in Figure 41. ‘The phasing plan emphasizes the urgent nature for the acceptance of the development programme for the city followed by quick implementation, ‘otherwise, spontaneous, uncontrolled and haphazard growth will ensue’ (Doxiadis, DOX-SAU-A19, 1968).

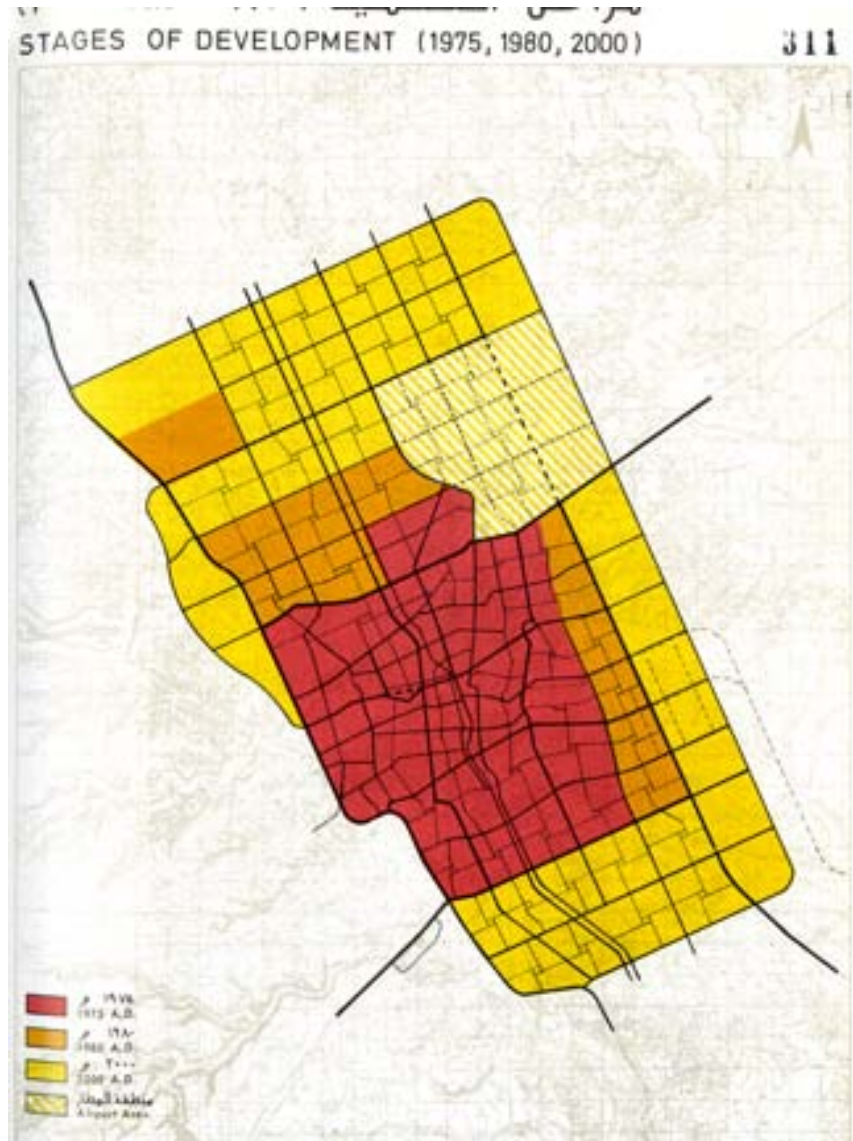


Figure 41 Stages of Development of Urban Areas Doxiadis Master Plan 1972

There is an absence of a phasing strategy or impact study for the region of Riyadh. The various phases of city development were defined on considerations of the expected population growth, the area needs, and the present trends in physical expansion. Many assumptions defined Doxiadis' growth projections such as the limitations of daily travel for commercial, social and civic needs which were assumed to be serviced from within the Modulus.

4.8 City and National Development Strategies

Impressive is the speed and scale of Riyadh's transformation particularly since and during the 1970's which has had few international parallels. The Saudi Arabian Council of Ministers overarching goal was to transform the nation from one of the world's poorest to one of the richest nations within a single generation. The risk they feared was that in pursuing sound economic and political strategies now might within a generation reverse the shift in the standard of living and leave an irreparable legacy of spiritual destruction that would affect the second or third generations.

C. A. Doxiadis was instrumental in assisting Saudi Arabia to develop their first National Five Year Plan, undertaking a survey of all settlements and regions of the Kingdom, and defining a development and modernization strategy. A subsequent commission by the Saudi Arabian Ministry of Interior to prepare an appraisal report for the past 5 years and a 5 year national development plan was accepted by Doxiadis in 1970. The Doxiadis team was accompanied by two assigned liaison officers from the Ministry of Interior, Mr. Galeb Zo'by and Mr. Abdulaziz Hussein. The team visited 42 out of 54 municipalities of the Kingdom during a period of slightly more than 5 weeks (Doxiadis, 1970).

The Doxiadis plan was rapidly set aside as Saudi Arabian Ministers began to establish their own goals and objectives for national development. The Second National 5 year plan is regarded as the Kingdom's first National authored planning strategy and outlines the first Saudi Arabian articulation of development goals for the Kingdom. Cranes analysis of The National Plan II Guidelines reveals four overarching goals, 16 subordinate objectives and a vast number of specific courses of action to implement these

objectives in order to assure that economic growth will not destroy Islam but rather will contribute to a new Islamic renaissance. National Prestige was not formally noted in 5 year national plans analyzed by Crane. (Crane,1978;11).

These four goals were to;

- 1) Increase the religious knowledge and sophistication of the individual,
- 2) Promote the role of individual initiative throughout the society and particularly in the economic life of the nation, i.e. to foster the cultural values of individual initiative embodied in the economic system of free enterprise
- 3) Strengthen the institutions underlying basic Saudi culture and promotion of the key institutions of Islam, which the highest ranking are the Hajj or pilgrimage to Mecca, the Bedouins as the living repository of Islamic values, and the teaching of the Shari'a.
- 4) Express the need to reduce the adverse impact of foreign influences (manpower and culture) on Saudi society and culture.

The challenge of accelerated economic growth in Saudi Arabia required greater sophistication to meet the challenges of the modernization process. One perceived danger was that western education and influences could destroy the Saudis' understanding of their own culture and moral and intellectual values on which their entire society is based was an enormous risk. A second major challenge of accelerated modernization addressed in the Plan II Guidelines was the uprooting of people caused by changing the society from a overwhelmingly rural to intensive urban base, which would destroy the sense of community essential to the survival of cultural values unless measures were taken to maintain their sense of community at all levels of society (Crane, 1978;10). Plan II guidelines adopt a pluralist approach permitting the various traditional groupings of

people in Saudi Arabia to modernize in their own way and at their own pace free from central direction and influence. This strategy in turn was based on the highly sophisticated understanding that the spiritual basis of individual and community life can coexist with and been reinforce success in mastering modern technology to provide a better material standard of living. A radical shift in the demographic makeup of Saudi Arabia was deemed essential for modernization and for the maintenance of equitable income distribution during the modernization process. Plan II Guidelines focuses on manpower planning to address this goal.

On May 18 1975 Saudi Arabia's Council of Ministries approved a second five-year plan budget of half a trillion Saudi riyals (142 billion \$) for the full five years. Minister of Industry, Ghazi al-Qusaibi expressed the challenge facing Saudi Arabia,

"I know many economist tell us, that we cannot compress the century-long process of development – infrastructure creation, manpower training, industrialization – into a few decades. But since no nation without resources has ever tried to do so, no one really knows if it can be done. We shall try."

Ghazi al-Qusaibi, 1975

CHAPTER SUMMARY

The master plan conception is a synthesis between the factual discoveries of the Ekistic research field work undertaken on Riyadh by the Doxiadis Associates Riyadh project team, and the Dynapolis urban design model which establish the new urban structure concept. The most influential factor dictating the master plans spatial form was the geography and topographical structure of the landscape and engineering surveys of surrounding lands which identified the suitability of areas for development. The master plan for Riyadh is unique amongst Post-War design strategies, in its compressive approach to urban expansion, and its conception of community structures and unique transportation schemes, and for its sensitivity to the existing urban fabric of streets of the existing 1968 city which became addressed in the transition connection strategy of the master plan.

The first master plan for Riyadh concentrates on the restructuring of existing urban areas to reflect a more flexible organization of territory that would enable growth and change of urban functions and scale. The strategy also established a long range vision for the urban structure to enable increasing capacity in its infrastructure and functional areas. Doxiadis design process built upon a scientific rigorous planning methodology which first assessed the surrounding context, spatial urban form and socio-spatial structure of the existing settlement. The analysis of the urban territory and its topographical structures became the starting point for devising the urban design strategy which was followed by studies of the existing settlement and its processes of growth, existing transportation structures, and socio-spatial contexts of existing community life.

Analysis of the data in turn informed expansion scenarios which assumed different approaches to restructuring of the transportation network. Population demographics and the settlements economic development potential were evaluated to determine and plan for the rates of population growth and urban expansion. The settlements spatial dimensions was established in tandem with projections of population growth rates and calculated through the prescriptive application of the ideal unit of the city, the Modulus. The development of detailed designs for the action areas emphasized Doxiadis' concern to establish a strong connection between the existing city and the new urban super grid.

The rapidness of the growth of the city immediately following the acceptance of the master plan points to the problem of establishing accurate population projections and estimating the dynamic of urban expansion. Doxiadis strategically organized the urban territory to operate in tandem with a real estate market forces. This resulted in the macro scales of growth for the city being achieved in a relatively short period after the plans approval and implementation due to the simultaneous release of land to the market. The supply and demand oriented infrastructure was immediately pushed to its service capacity limits as market development demands the extension of services at considerable expense.

CHAPTER 5

RIYADH'S URBAN EXPANSION 1972-1996

In the previous chapter the complexities of establishing scales of both aerial and population growth estimates emerged as the critical issue facing Doxiadis Associates as they sought to develop planning scenarios and phasing of development. This chapter examines the realities of Riyadh's urban expansion specific to spatial structure and population expansion, and introduces the current direction of development as outlined in the current comprehensive plans, MEDSTAR. This chapter delivers insights on how the first master plan shaped urban expansion, territory and infrastructure in a way which has sustained the plans strategic spatial form at both the macro and local urban scales.

5.1 Revision of the Doxiadis Master Plan 1978

The first master plan with its clear emphasis on the northern growth activity axis began to be implemented immediately after its approval in 1972. The plan established a compact urban area of 304 square kilometers, of which 150 square kilometers was allocated for residential development to accommodate a population of 760,000 to the year 1985, and 1.4 million to the year 2000. The urban design strategy concentrated on the organization of territory by establishing a macro structure for the city with local district designs to guide the development of neighborhood communities. Territory was inscribed by a comprehensive transportation system of roads that formed spatial boundaries for the nested system of Ekistic community classes. Market forces propelled the development of multiple moduli (Community Class V) and these spatial units rapidly extended the spatial area of the city. Infrastructure services water, electrical, and communications

were extended to supply services to these new areas. Almost immediately a crisis emerged in regard to the development of services and new infrastructure to meet the capacity requirements of the expanding city.

SCET International, a French consulting firm with expertise in urban infrastructure development, was hired to review and revise the Doxiadis master plan in late 1978 in collaboration with the local town planning firm Abdal-Aziz Samkary. The SCET plan was a twelve year proposal that was never formally adopted by the Saudi Arabia, that attempted to coordinate overall policies for the physical structure of the city and the actions of all Government agencies involved in development (Daghistani,1995). The ability to predict requirements and develop strategies for the provisioning and management of electricity and the supply of potable water, and sanitation services was urgently needed in the face of rapid growth. The development of a coordinated phasing strategy which incorporated the participation of Government agencies was identified as a central task. A second critical aspect of the project was the development of water infrastructure supply and management for the city. The SCET plan assumed a growth rate of 3 percent per year.

Doxiadis death in 1975 raised a serious problem for the Saudi officials involved with the master plan, as the implementation of the plan revealed the need for ongoing adjustments of the master plan and it's phasing to correspond with the city's rapid growth rate. The built up area of Riyadh in 1977 extended to 73 square kilometers and the market demand for residential development outpaced supply, forcing the municipality to continually extend the development of new urban areas. Residential developments were pushing beyond the planned limits of the city, in effect doubling Riyadh's metropolitan

footprint. Preparations for the new low income housing program discussed by the Saudi Arabian delegation with Doxiadis in Athens in 1969, was developed to the south west of the historic central business district. This development of housing was in proximity to the industrial districts of Riyadh further strengthened the concentration of commerce and services in the historic central business district. The new housing program to be establishes was not part of the Doxiadis Associate scope of work, and therefore was not addressed by detailed design proposals or noted in the master plan structural scheme. This development is clearly visible within the SCET master plan and had been developed outside of the Doxiadis master plan framework which had considered the area to be unsuitable for residential development due to its geographical topography which would raise the cost of supplying infrastructure to the area.

These new housing developments required technical integration with the existing infrastructure of the settlement and the new Doxiadis master plan organization of infrastructure. The Doxiadis scope of work had explicitly removed an analysis of water infrastructures and supply for the city from the master plan project. SCET's expertise was in the development of urban and national infrastructures. A holistic evaluation of services to support the city was mandated in tandem with the requirements to develop a revised expansion phasing plan.

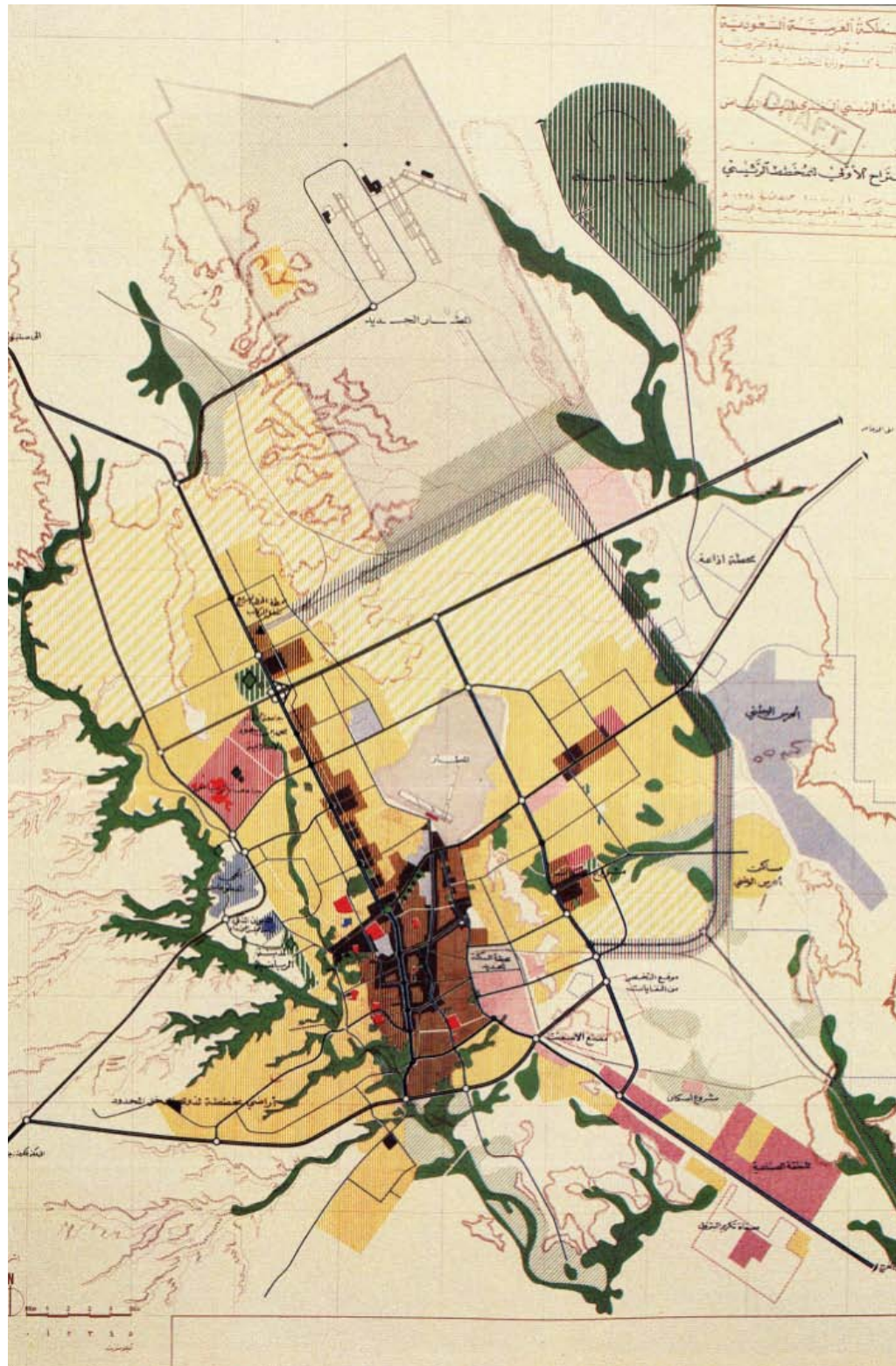


Figure 42 SCET 1978 Revision to the Doxiadis Master Plan

The SCET development plan focused on three modes of growth within the metropolitan area, strategies for the provision of services in developed areas of the city, new growth was channeled along two axes as outlined by the Doxiadis master plan to maintain the structural form of the city. According to the SCET plan (Figure 42) higher density development was identified to occur along existing important arterial roads surrounding and extending from the urban core. The SCET plan also introduced a ring road as a strategy to provide rapid connection to all districts of the city. Residential development was to occur to the north and north east of the city following the Damman road.

The renewal of the historic urban core of the city was also considered as a key component of the development phasing strategy. Three action areas were identified by the SCET strategy, with the demarcation of action area's following boundary limits of the road network but with little or no concern evident for the morphological form of the spatial fabric as is seen in Figure 43. Detailed architectural oriented strategies and development plans were proposed by SCET which concentrated on the urban renewal of streets and promoting the development of commercial centers. These strategies may be characterized as land use plans which aimed to develop a visual identity for the city based on short term development. The organization of territory in the SCET plan ignores the formal structure of the Doxiadis grid and modulus entirely and attempts to define community organization with a focus on the transportation network which became the defining element which has defined the spatial character of the city in its eastern and southern expansion.

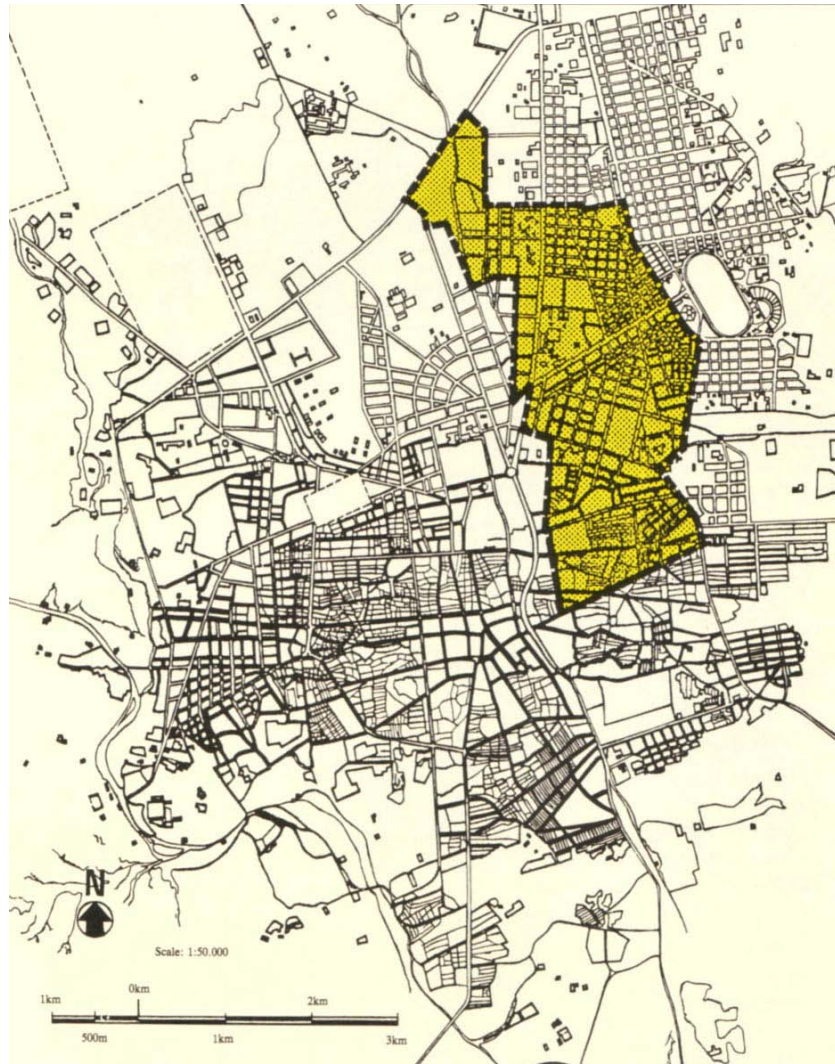


Figure 43 SCET Action Area 2

The SCET plan was never formally approved but did contribute to the expansion of the city specific to new distributed subdivisions around Riyadh, such as the expansion of industrial areas to the south east and location of new residential districts east of the old airport. The plan developed by SCET returns the city structure back to a radial growth pattern about a single centered settlement. The development focus is on transportation infrastructure which becomes linked to commercial development.

5.2 Aerial Expansion of Riyadh

The rapid expansion of the city four years after starting to implement the first master plan led to the re-evaluation of infrastructure and the master plan by SCET commissioned to make revisions to the Doxiadis master plan. By 1979 according to Al-Sahhaf the areal extents of the city had expanded to 162.3 square kilometers and included 38.60 square kilometers of vegetated lands. The city had achieved the Doxiadis projections of urban growth in seven years, a sharp contrast to the area expansion outlined by Doxiadis which was to unfold over thirteen years. Under the SCET plan the expansion limits were established to the year 1990 and were to be 850 square kilometers to accommodate a population of 1.6 million. Outside the limits of the Doxiadis plan, 250 square kilometers of vacant subdivisions were established which in effect doubled the metropolitan footprint. The central urban design strategy of the 2 km x 2 km grid framework, the basic building block of communities as outlined in the Doxiadis master plan was carried forward into the SCET revision but was not demonstrated in the revised structuring plan.

Dissatisfaction with the Doxiadis residential district layout also propelled a search for new traditional neighborhood and community planning designs which resulted in a number of pilot projects such as The Ministry of Foreign Affairs housing (1979) the Diplomatic Quarter (1982) and subsequent MOMRA initiatives to develop neo-traditional residential communities within the spatial unit of the Doxiadis super-block. The imperative need for an urban-regional strategy began as emphasis shifted from the local scale to the urban-region due in part to ecological outcomes of the previous urban strategy and the continued rapidly expansion of the city

By the 1980's The Ministry of Municipal Affairs (MOMRA) instituted a nation-wide moratorium on the urban expansion and instituted boundary controls to limit urban development until new urban development strategies could be developed. MOMRA and various planning authorities across the nation began to evaluate alternative planning approaches to contain the phenomenal expansion of Saudi Arabian cities which was straining infrastructure and governance capacities.

The Ministry of Municipal and Rural Affairs moratorium on urban expansion policy Resolution 175, instituted metropolitan outer boundary limits. Urban Limits Phase I established an area of 632 square kilometers to be set aside for urban growth 42 percent of which was undeveloped. Urban Limits Phase II set aside an amount exclusive of Urban Limits Phase I, of 1,149 square kilometers to accommodate urban expansion between 1995 and 2005. Riyadh's socio-spatial structure and various developments have been determined by the continuous rapid growth of the residential real-estate market, state institutions and industrial state owned enterprises, and administrative governance of urban functions. The most recent urban strategic framework for Riyadh, MEDSTAR notes that extensive tracts of undeveloped land remain within the Urban Limits Phase I area as of 1996 (MEDSTAR, 1996).

As a result of the re-evaluation process, a new comprehensive development planning program referred to as MEDSTAR was adopted for Riyadh in 1996. The new strategy reflects a major shift in how urban processes, space planning, management and governance are conceived and implemented. Developed by the Arriyadh Development Authority adopted by the High Commission for Arriyadh the MEDSTAR approach is a comprehensive value driven action strategy that integrates urban governance, economic

development, urban identity, regional development, urban growth and infrastructure. It is a document and process that defines, develops and institutes an ongoing dynamic metropolitan planning process. The first MEDSTAR 2021 Draft Regional Strategic Plan was finalized in 1997 and has recently undergone revision and update in the spring of 2009.

Many scholars note that Riyadh's population growth over the past fifty years does not fit a constant simple exponential growth model of natural populations (Al-Sahhaf, 2000, Al-Khalidi,1992). The growth of Riyadh was exceptional and as of 1968 the population of the city was already 300,000 persons with forecasts by the public utility agencies projecting 330,000 residents for 1985, and 400,000 for 1995. The capital city's population continued to increase between the years 1975 and 1985 by 113 percent, with dwelling units increasing by 108 percent. Al-Sahhaf suggests that the level of migration to the city was resulting in housing shortages, and an increase in population densities.

Riyadh's change in population has been calculated to be 7.3 percent annually (assuming a constant growth rate over those 15 years) with a population growth rate of 8.25 percent between 1965 and 1972. With the onset of oil exploration and development the growth rate of Riyadh between 1972 and 1979 reflects an annual rate of around 10 percent in terms of an equivalent constant growth model with a continuation until 1991. From 1991 to 1999 the growth rate of the city has slowed to 7.2 percent annually between the years 1991-1994, and 3.25 percent. The main aspect of urban spatial structure is the clear differentiation of neighborhoods in terms of nationalities and regional status arising mainly as a consequence of the high rates of internal and expatriate migration during this time (Al Sahhaf, 2000).

The analysis of growth of Riyadh undertaken by Al-Sahhaf (2000), utilizing satellite imagery and aerial photographs focuses on Riyadh's urban growth patterns, and reveals the rapidness of urban expansion and direction of shift in the urban spatial form of the city is reflected in Table 3. Significantly the total area of the city was found by Al-Sahhaf to increase 225 times its original size in the last 50 years, due primarily to residential sprawl. A trend of decreasing population density in the city since 1950 was also noted. The high level of population growth was paralleled with the rapid execution of the Doxiadis master plan to meet market demand. The universal spatial unit ability to aggregate to the existing structure of the city, with the ease of infrastructure extension enabled the rapid development of new areas to be delivered to the marketplace. This process of market driven spatial growth and the intuitive nature of the urban design module ensured the continuity of the urban design over time. Interestingly, Al-Sahhaf's comparative research specific to Riyadh's processes and patterns of spatial expansion and the traditional models of urban growth such as The Concentric Zone Model, Burgess, 1925; The Sectoral Model, Hoyt, 1939; The Multiple Nucleus Model Harris and Ullman, 1945, does not acknowledge the influence of C. A. Doxiadis' model of Dynapolis and master plan for Riyadh as a significant factor of expansion (Al-Sahhaf, 2000).

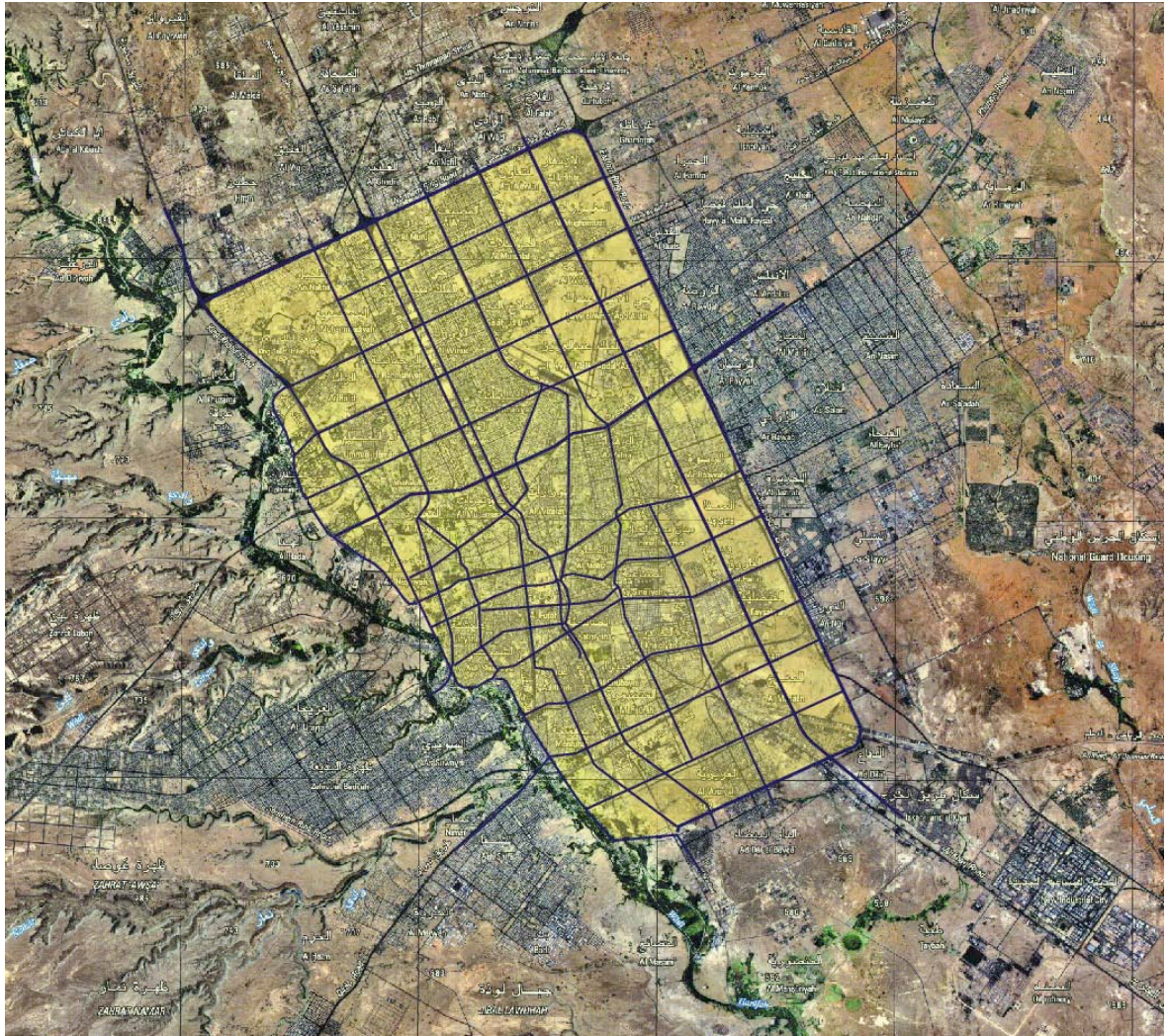


Figure 44 1972 Doxiadis First Master Plan Overlay on Aerial Photo of Riyadh 2001

Table 3 Comparison of Urban Expansion by Extents and Population

<i>Urban Analysis Type</i>	<i>Developed Urban Area Sq. Km.</i>	<i>Population Estimates</i>	<i>Direction of Expansion</i>
1950 B & W Aerial Photograph	2.7 Sq. Km. (Total Urbanized Area)	83,000	Expansion beyond walls of city with residential areas expanding along an East – West axis. Temporary settlement-shanty towns observed.
1965 Black and White Corona satellite aerial Photograph	26.7 Sq. Km. (Total Urbanized Area)	231,000	Rapid expansion towards North and North West and South. Residential growth in all directions.
1972 Black and White Corona Satellite Photograph	39.3 Sq. Km. (Total Urbanized Area)	350,000 609,000 -662,000	Dense development in South and South East area of city.
1979 Landsat Multispectral Scanner	162.3 Sq. Km. (Total Urbanized Area)	760,000	Super expansion in all directions.
1991 Landsat Thematic Mapper TM Image	312.4 Sq. Km. (Total Urbanized Area)	2,500,000	Extensive urban expansion East and concentrated development North. New residential expansion to South West
1994 SPOT Image	480.1 Sq. Km. (Total Urbanized Area) (140 Sq. Km increase in residential growth from 1991 observed)	3,100,000	Growth is occurring to the East and North of the city.
1999	612 Sq. Km. (Total Urbanized Area)	4,194,000	Infill and Densification of areas within urban area.

5.3 Population Growth

C. A. Doxiadis considered a population increase of 4-5% per year to be a crisis of increasing urbanism.

The principle criticism of the Doxiadis master plan in the decade after its approval and implementation was that it failed to adequately estimate population expansion. Throughout the master plan minutes, memorandum and working documents, tensions to establish an accurate rate of population increase is noticeable. The Saudi officials

consistently placed emphasis on projections of an annual increase in the order of 10 percent. For Doxiadis a crisis of urbanism occurred when populations expanded at a rate of 4 to 5 percent annually. Clearly establishing population estimates and growth projections for Riyadh became a serious challenge requiring continuous revision. The official view in Saudi Arabia estimated current population to far exceed the survey of population conducted by the Ministry of Finance taken in 1962/63, which determined the country's population to be about 3.3 million persons. This figure was considered to be substantially lower than most of the earlier guesses, which put the country's population at figures between 5 and 10 million persons. Estimates for Riyadh's population in 1930 was of the order of 30,000 growing to 80,000 in 1951 reflecting an average annual rate of population increase from 1930-1951 of about 4.5 percent. Three surveys were undertaken quite close to one another yielded an average annual growth rate for the city of Riyadh of about 7 percent per annum for the period of 1951-1962, a rate of nearly 10 percent for the period between the first and second survey and a rate of nearly 8 percent for the period between the second and third survey (Doxiadis Associates, 1968).

Doxiadis Associates viewed the rate of growth implied by the figures of the first and second survey to reflect an overestimate and suggested that the average annual rate of population increase of the city of Riyadh in recent years reflected an 8 percent increase. Impressions of informed local sources raised the rate in question to more than 10 percent, considered by Doxiadis Associates to be an overestimate. Informed authorities in Riyadh put the birth-rate at 40-45 percent and the death rate at about 20 percent allowing for a natural rate of population increase of about 2-2.5 percent per annum.

The difference between the natural rates of population increases was attributed to immigration. The study of growth during the period of the master planning preparation reflected a large discrepancy or increase in population and new construction starts. The unusually large difference during a period of two years was discounted as sampling error. In hindsight perhaps greater significance should have been assigned to this phenomenon. The rate of Riyadh's population growth is expected to remain very high but decline from the current annual growth of 4.2 percent to 2.5 percent in 2030. This forecast increase is still significant as an increase from a current population of 4.75 million (2008) to 8.30 million in 2030 will mean an increase of 3.55 million people. The trend today is for architecturally designed mixed use residential mega projects which offer the potential to be fully planned and integrated communities offering a range of housing, high standard community facilities, open spaces and local employment. Over the next 20 years MEDSTAR estimates that over 30,000 households will be formed on average per annum in Riyadh and will be seeking housing in the market. The total projected dwelling growth over the plan period is 700,000 new dwellings, almost double the present number of dwellings in the city (770,000).

Significantly the rate of population increase has exceeded the projections made by Doxiadis for the master plan. In hindsight the critical error made by Doxiadis was to assume that the difference of rates of increase was due to sampling error by Saudi Arabian agencies. This was combined with Doxiadis' position which held that the rapidness and scale of population growth of Saudi Arabia would follow typical trends.

Table 4 Estimated Growth of Riyadh's Population to 2000

Year	Population	Source of Census or Estimate
1862	7,500	Palgrave, W.G. (1908)
1919	19,000	Phillby, J.P. (1922)
1930	27,000	Rough, W. (1969)
1935	36,000	Ministry of Interior (1968) Building Survey
1940	47,000	Ministry of Interior (1969) Building Survey
1944	61,000	Twitchel Report (1953)
1949	83,000	Ministry of Interior (1968)
1954	106,000	Ministry of Finance & Nt'l Economy(Census,1962)
1960	160,000	(T.P.O adjusted by Doxiadis)
1962	169,000	Ministry of Interior (1968) T.P.O.
*1965	231,000	Mohamad Ridha Al-Jassim
1968	300,000	Al-Shareef (1975)/ Doxiadis Household Survey
1970	350,000	Ministry of Finance & Nt'l Economy (Census,1976)
1974	609,000	Ministry of Municipalities & Rural Affairs (1978)
*1974	662,000	Population Census 1974
*1977	690,000	Al-But'hie Dissertation (1996) – RAMP Socio-econ. Survey
*1978	760,000	Al-But'hie Dissertation
1981	1,100,000	Daghistani (1985)
1982	1,206,700	Daghistani (1985)
1983	1,323,750	Mecci (1987)/Daghistani Forecast (Al-But'hie Dissertation)
*1986	1,389,000	Arriyadh Development Authority (1987)
1986	1,517,000	Ministry of Municipalities & Rural Affairs (1977)
1990	1,750,000	Al-Naim (1987); Al-Hammad (1987)
1990	2,200,000	
1991	2,500,000	Based on the rate of growth between the two
1994	3,100,000	(Al-Naim,1990;Mecci,1986 estimate)
2000	4,194,000	Arriyadh Development Authority (Estimate 1999)

Source: (N.A. Al Sahhaf Dissertation, 2000, A. Telmesani, Dissertation 1989 (Telmesani,1989), Al-But'hie, 1996 Dissertation)

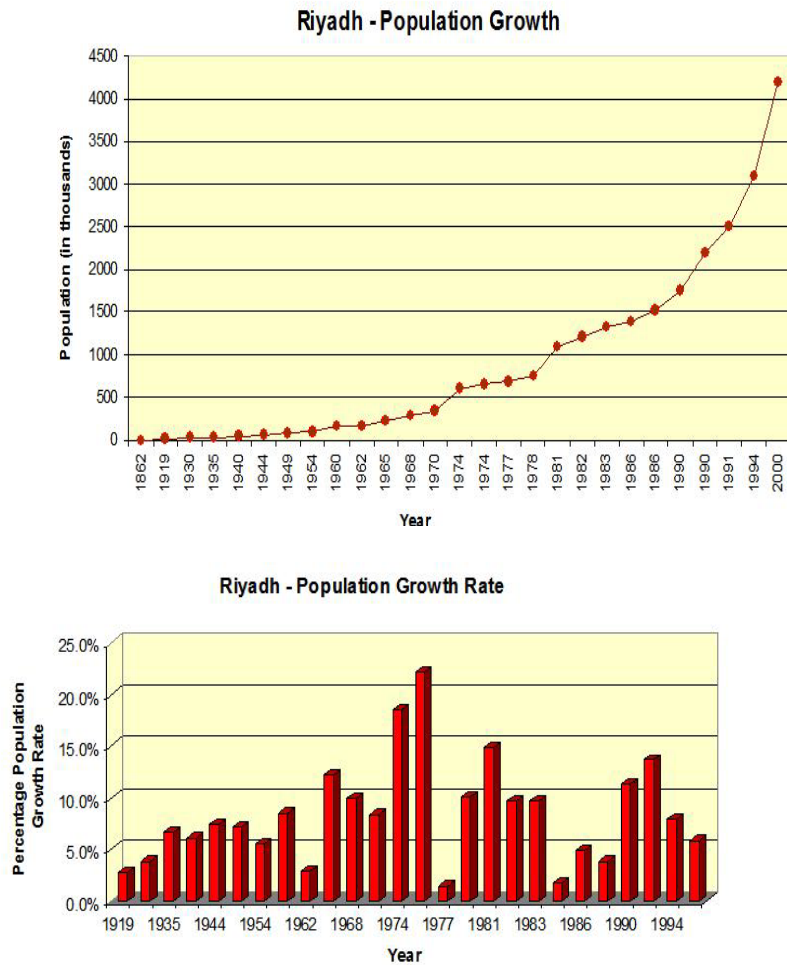


Figure 45 Population Growth Rates 1919 – 2000

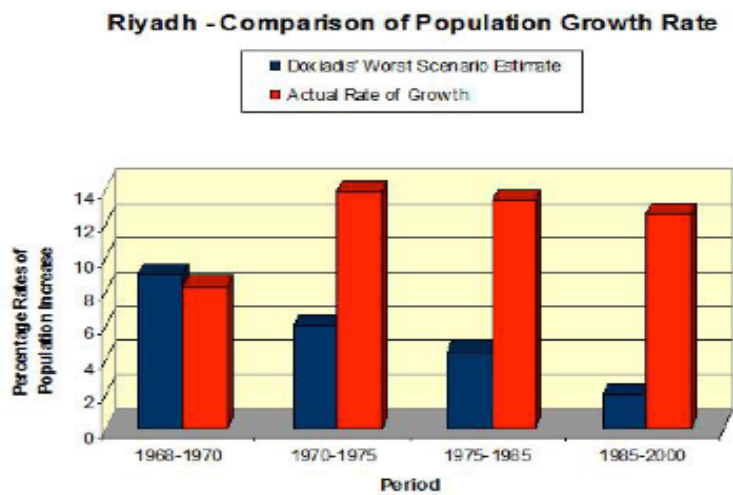


Figure 46 Comparison Doxiadis Projection of Riyadh Growth Rate and Actual

5.4 Implementation

Implementation of the master plan concentrated on establishing the northern spine and inscribing the 2 km x 2 km blocks perpendicularly aligned to the northern oriented axis. A system of aggregation by super blocks began to shape the new form of the city as presented by the Doxiadis master plan. The northern spine as the central direction of urban expansion still maintained its importance as the principle axis and concentration of development. By 1976 two axes were clearly informing the urban structure. The Khurais Road towards Dammam began to exert its force as an attractor of development. With the development of the new ring road with its eastern emphasis, the emergence and continual strengthening of a second eastern axis occurred.

How the role and function of the street or roadway is positioned within Doxiadis' theory of Ekistics and the model of Dynapolis is significant. The emergence of a multiple axial structure for Riyadh reveals an important tension in Doxiadis' theoretical thinking specific to perception of spatial form and growth dynamics. Doxiadis principle consideration of the 'road' was its constitution of a boundary edge which would facilitate movement and through proper location optimize access ranges to diverse areas of the city. The strongest axial roadway would establish the direction of urban expansion when accentuating or defining the alignment of future urban centers which would follow the commercial strip bounded by closely paralleled streets. Across both the macro and micro scales of spatial planning the road is used by Doxiadis as a boundary edge which defined the unit of spatial area, block at all community class scales. The perception of road as an 'active center' was absent from Doxiadis' theory and model of Dynapolis which is in

contrast to many of the Post-War architects such as Louis Khan and the Smithson's who viewed the road as central component formulating urban life.

Losche's (1954) principles suggest that urban expansion is linked to the extension of economic service areas and functional development along road networks connecting urban centers with their region. This proposition is adopted by Doxiadis as a key fact of urban expansion, and generatively instructed his placement of service and commercial functions along the principle highways and roads inscribing the modulus unit. The importance of the east-west freeways as an extension of Khurais Road and as a secondary force influencing subsequent urban expansion was not acknowledged by Doxiadis in his design scenarios, rather these roads to constitute boundary edges that inscribe territory.

During a meeting July 28 – August 4, 1969 in Athens to review the preliminary master plan, two aspects of the discussion by Saudi authorities and Doxiadis and the senior project planners highlight issues of urban spatial form. The first issue was that development commitments were identified to have been made along specific urban arteries such as Khurais and Hejaz Roads, the second was an expression of concern for the allowance of the east-west freeway to be a continuation of Khurais Road which was perceived by Saudi Arabian officials to divide the future city at its middle. The Lord Mayor of Riyadh Thanayen, Mr. Rassem Shaath and Dr. Azzam who had pointed out that although the plan prefers development of the city towards the north-northwest, roughly parallel to Wadi Hanifa, commitments had already been made in other directions, mainly towards Khurais and Hejaz roads, that should be also taken into consideration and shown in the development plan even if they were secondary.

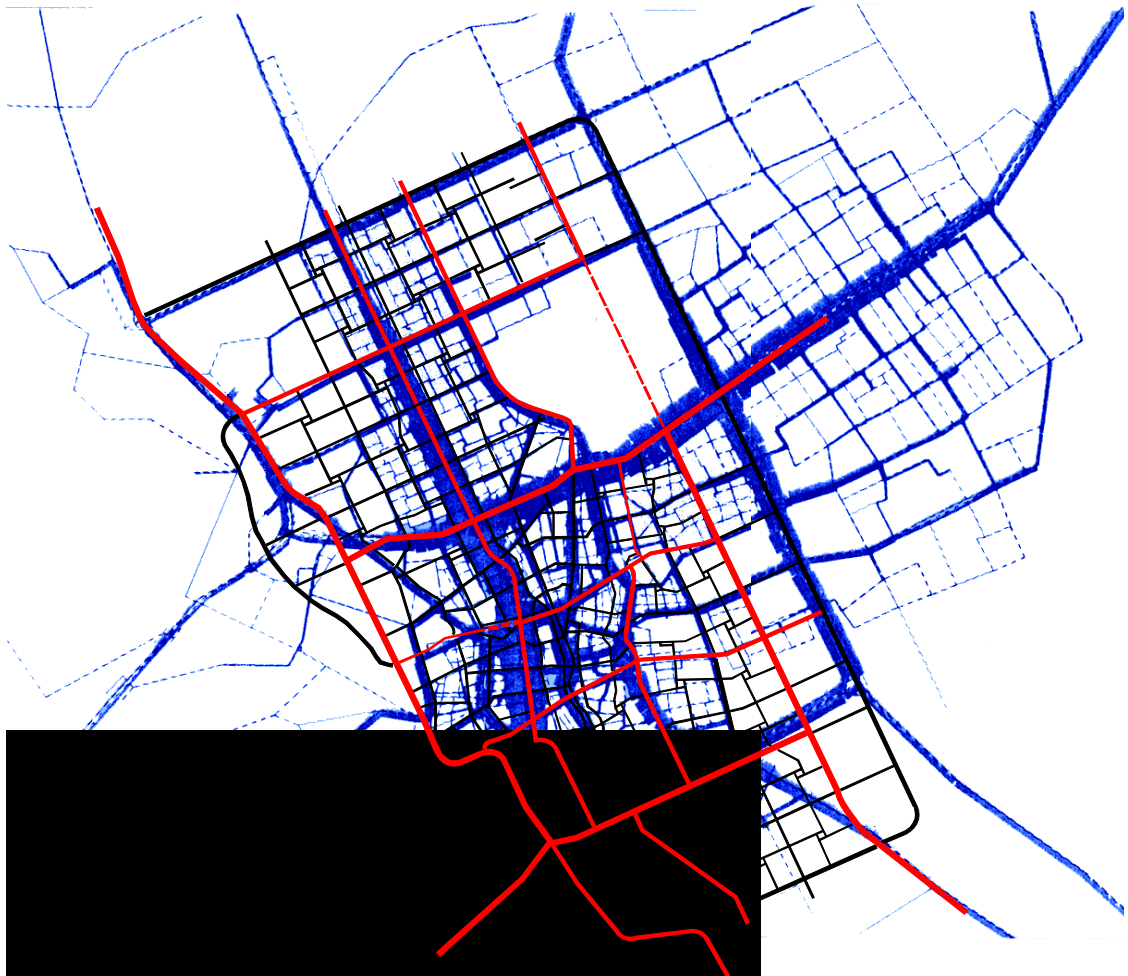


Figure 47 1996 Traffic Volumes Overlaid on 1972 Master Plan Road Hierarchy

Doxiadis stated that such commitments should be taken into consideration, noting that due to budget limitations for the development of the city, the development plan would also include the developments or commitments made along Khurais and Nejaz roads, but that the main investment of development funds would concentrate in the main body of the city where problems were more acute and technical solutions immediately necessary.

The second point was in regard to roads and was made by the Ministry of Communications enquiring as to whether it was justified to allow the east-west freeway,

shown in the master plan as a continuation of Khurais road which was perceived to divide the future city at approximately its middle. The participants in the meeting agreed that in a metropolis approximately 26 kilometers from northwest to south east and 12 kilometers from northeast to southwest, it was impossible to avoid certain major thoroughfares to cross the city from one site to the other. It was stressed that the structure of the master plan divides the city into integrated townships each with its own central section and system of circulation and activities. The freeway mentioned forms the dividing line between two such big communities, and does not therefore interfere with its internal life or movement. The role of the street or road within urban expansion is constituted by Doxiadis as a firstly a conduit for movement and secondly as a boundary edge defining territory. The road structure proposed by Doxiadis has attracted commercial development to occur in tandem with the implementation of the road network. This is in opposition to Doxiadis' plan for Riyadh and the theoretical premise of Ekistic community classes which established the formation of multiple centers to be imbedded within a bounded territory of the modulus. The master plan did not assign a functional distinction to community class VI peripheral edges as shown in Figure 33. Detailed zoning plans also placed commercial functions within the activity spine of the city and do not highlight either side of the road network for commercial zoning.

In Riyadh commercial development occurs on the modulus boundary edge highlighting the relationship between traffic movement flows and active commercial areas. This in fact was not planned to occur by Doxiadis and has had two far reaching impacts on the spatial form of Riyadh. Firstly the oversupply of commercial strips and formation of commercial centers placed in tension the imbedded centers which were to

develop within the modulus district. The uneven and long length of time for a modulus district to develop has resulted also in the inability of the modulus to establish active community life within its interior. Secondly this resulted in a highly distributed development of commercial functions along roads across the city, which did not establish high density urban centers to form within the modulus spine.

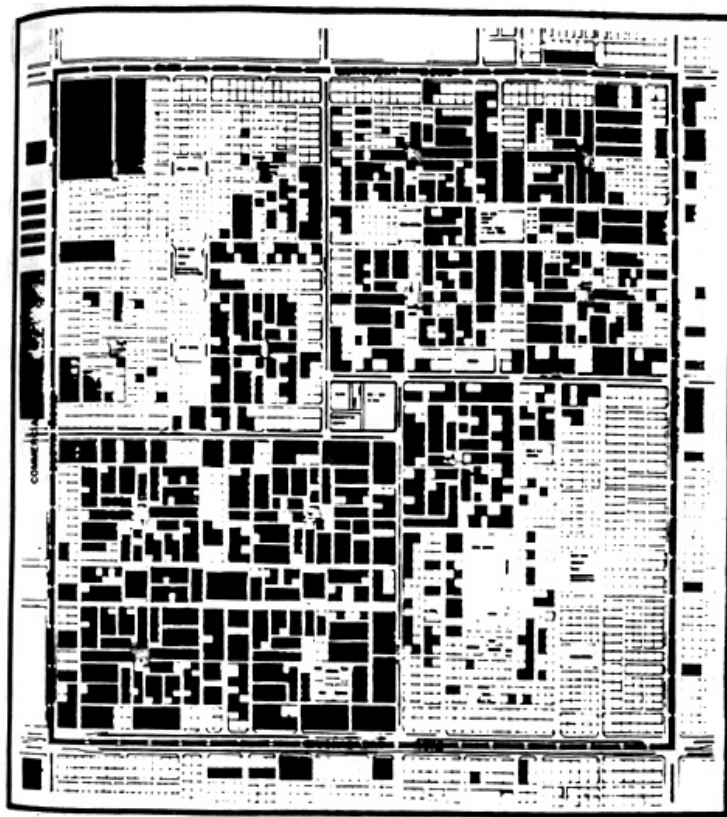


Figure 48 Urban Open Space Study King Faud Sector, 1986

Doxiadis strategy also placed emphasis on the creation of multiple nested centers established within the various hierarchical community class scales. The phasing of development and the process of change has resulted in three problems. The first was that urban centers were unable to materialize due to a process of uneven residential

development across the modulus over a long period of time which resulted in the inability to form Ekistic communities as outlined by the Doxiadis' theory. Al-But'hie (1986) observes in his study of open space and existing land use in 1986, that only 36 percent of the total area has been built in the King Faud District of Riyadh, and that this development reflects a diagonal pattern with two distinct areas having been planned and built since the last 14 years. The uneven residential development of the interior of moduli across the city has resulted in the incomplete formation of communities, and excessive large expanses of open space.

Second the concept of active and lively interior commercial centers envisioned to create the synthesis within the modulus also did not form due to the absence of economic viability of the sparsely developed modulus. Instead peripheral commercial strips began to develop along the perimeter of the modulus facing the high volume streets which brought greater economic exposure and benefit.

The current redevelopment processes relating to the re-zoning of land within the moduli from residential to commercial, is resulting in the massing of land parcels to introduce mega projects. The process of 'intensification' of development specific to shopping malls and office towers, is creating the juxtaposition of extreme scale differences in the local residential community, raising visual privacy and traffic concerns. The loss of visual privacy for residences and communities adjacent to the megaprojects which go beyond residential heights and combined with the juxtaposition of spatial scales challenges the future formation of community life within these districts.



Figure 49 Aggregation of Small Blocks for Redevelopment of Modulus, Google Earth 02- 2009.

Urban areas adjacent to the activity spine are currently experiencing redevelopment pressures to be rezoned from residential and light commercial to high density commercial as can be observed in Figure 49. The result of this strategy is the juxtaposition of mismatching urban scales and function with the ultimate loss of the finer grain urban fabric and community class legibility within the interior of the modulus. Doxiadis considered the subdivision of large blocks into smaller blocks and the opposite consolidation of small blocks as larger blocks as a strategy to support urban

transformation and change. The generation of larger land divisions would accommodate the development of larger complexes where the expansion of functions could occur. This was a flexible aspect of the modulus that would accommodate transformation over time.



Figure 50 Photograph of Villa Housing in Riyadh, ADA 2009



Figure 51 Photo of Duplex Housing in Riyadh, ADA 2009

Demand for low density single family villas at a dwelling density of 10 per gross hectare as predicted by MEDSTAR study's will greatly increase the area of the urban footprint, as well as the demand for land and the spread of services such as roads, water and sewerage. Figure 52 reveals the approved subdivisions in Riyadh since the 1980's. The plan reflects a concentration of development to the north and eastern region of the city adjacent to the international airport. Several existing smaller blocks which have been developed previously are integrated into the city utilizing the previous investment in infrastructure. It is notable that major area of land released for development and subdivision is situated to the south-west of the city across the Wadi Hanifa. The Wadi has previously has served as a natural edge to the city and challenged the provision of infrastructure services outside the cities spatial continuous environs. The outer ring road is an attempt to unite these developments and at the same time form a limit boundary for development expansion.

5.5 Riyadh's New Urban Strategy MEDSTAR 1996 -2021 & Revised 2030

The current MEDSTAR comprehensive plan adopted by the High Commission for Arriyadh and developed by the Arriyadh Development Authority reflects a major shift in how the spatial form of Riyadh is conceptualized, developed and governed. The new planning approach is a comprehensive value driven action strategy that integrates urban governance, economic development, urban identity, regional development, urban growth and infrastructure. The first MEDSTAR 2021 draft regional strategic plan was finalized in 1997 with the 2009 MEDSTAR revision extending development to 2030. The aim was to formulate a 50-year vision, a 25-year strategic framework and a 10-year

comprehensive implementation plan for the city and its region which will be continuously updated at regular intervals.

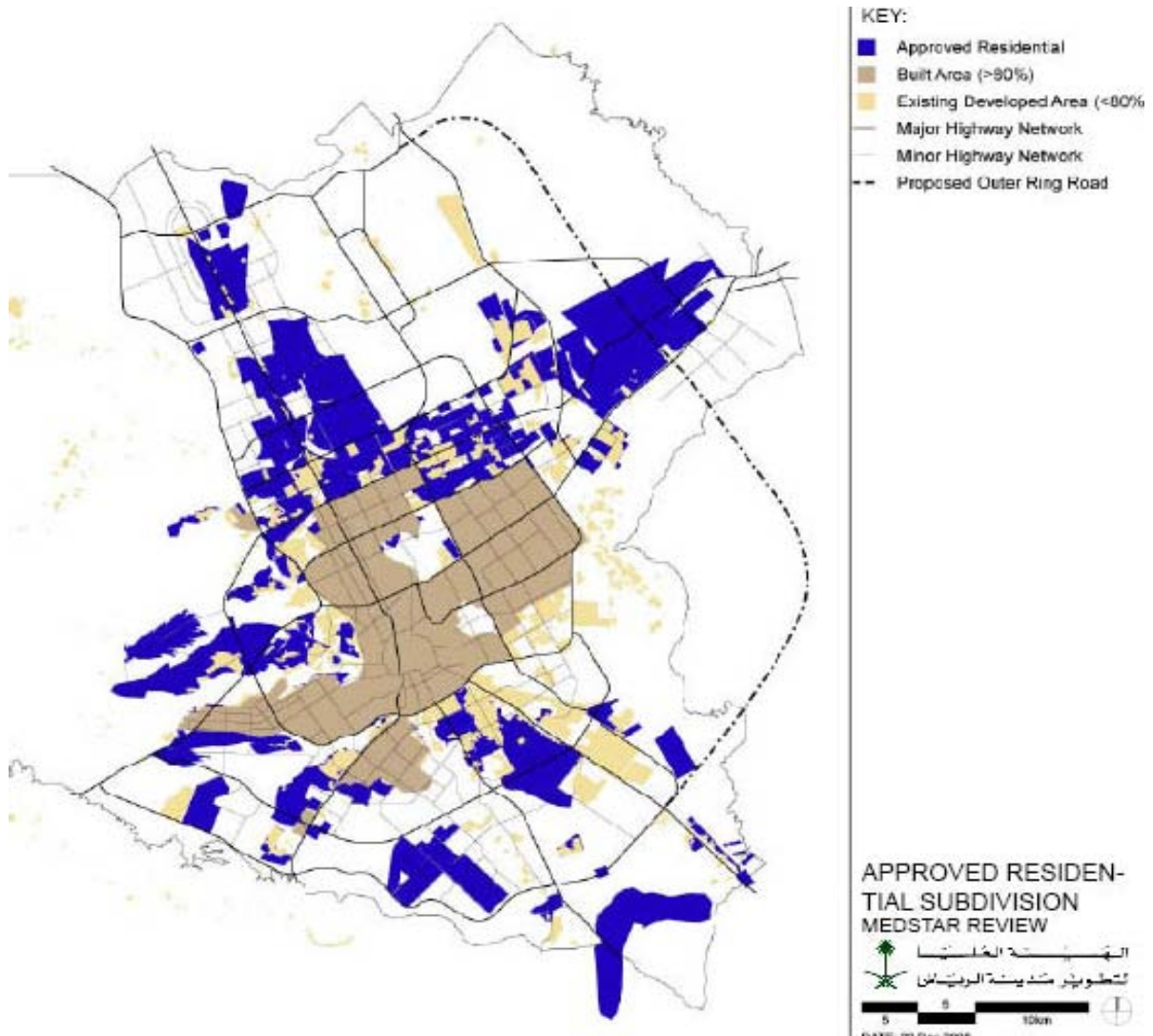


Figure 52 Approved Subdivisions since the 1980's in Riyadh © ADA 2008 MEDSTAR Review

The MEDSTAR strategy is modeled after the 1991 Australian 'Building Better Cities' (BBC) program which aimed to build a new collaborative partnership in urban governance. Dr. Lyndsay Neilson oversaw the creation, development and implementation

of the BBC program. 'The purpose of the Australian program was 'to promote improvements in the efficiency, equity, and sustainability of Australian cities, and to increase their capacity to meet the following objectives; economic growth, and micro-economic reform, improved social justice, institutional reform; ecologically sustainable development; and improved urban environments and more livable cities.' (Neilson,2008).

The original scope of the first Metropolitan Development Strategy for Arriyadh was to identify the problems and development potential that existed in Riyadh and its region, and develop various scenarios and approaches to inform the design of a spatial and structural plan. This planning program began to integrate traditional planning concerns with ecological and environmental projects which increasingly were addressing emerging problems such as high water and the Wadi Hanifa watershed. Water originally viewed as the limiting resource that would constrain the cities development potential has become an unexpected planning problem due to the increasing incidence of rainfall and flash flooding and the emerging problem of continuous high ground water throughout city districts.

The city's population is currently above 4 million people and has grown at 8 percent per annum. The population forecast prepared for MEDSTAR in 1996 – 98 predict populations of 12.3 million, 10.5 million and 8.6 million people respectively based on high, medium and low forecasts for the year 2021. Since 1996 net migration to Riyadh from other parts of the Kingdom was more than halved from 75,000 persons per annum in early part of this century. As a consequence the anticipated growth rate for Riyadh had reduced from 8 percent per annum to 4.2 percent pa and the consequent total population forecast for 2021 is not well below the MEDSTAR forecast of 10.5 million

people. Slower growth is also driven by the reduction in the reliance on foreign labor. Natural increase among Saudi families remains strong in a very young population and is the main source of future population growth (MEDSTAR Review, 2009). The new revised structure plan 2030 Map for Riyadh (Figure 54), reveals the broad intentions for urban infrastructure and land use, and provides for policies and actions for the physical development of the city.

The capital city is to be enhanced with a focus on the renewal of the central city and its adjacent areas to reflect the culture and traditions of the Kingdom. The major commercial centre at the heart of the city will be supplemented by a number of metropolitan sub-centers which will provide concentrations of commercial and public activities in proximity to sub-regional populations. High-density spines are supported by the sub-centers, and terminate at two new cities shown in yellow in Figure 53. These new cities will have districts to accommodate between 50,000 – 100,000 persons with gross residential densities in the range of 10-20 dwellings per hectare in district groupings (ADA, 1999). In addition the development of urban nodes, shown in red, are planned to be high density, mixed use developments which will reflect the concept of a hierarchy of centers to serve community needs. These centers are situated in the rapidly expanding urban growth sectors of the city based on a 10 kilometer radius located on key intersections on the city's future expressway/arterial road network and the new public transport routes. Significantly the Riyadh region is incorporated within the comprehensive plan with projects such as the ecological remediation of the Wadi Hanifa highlighted as key urban projects.

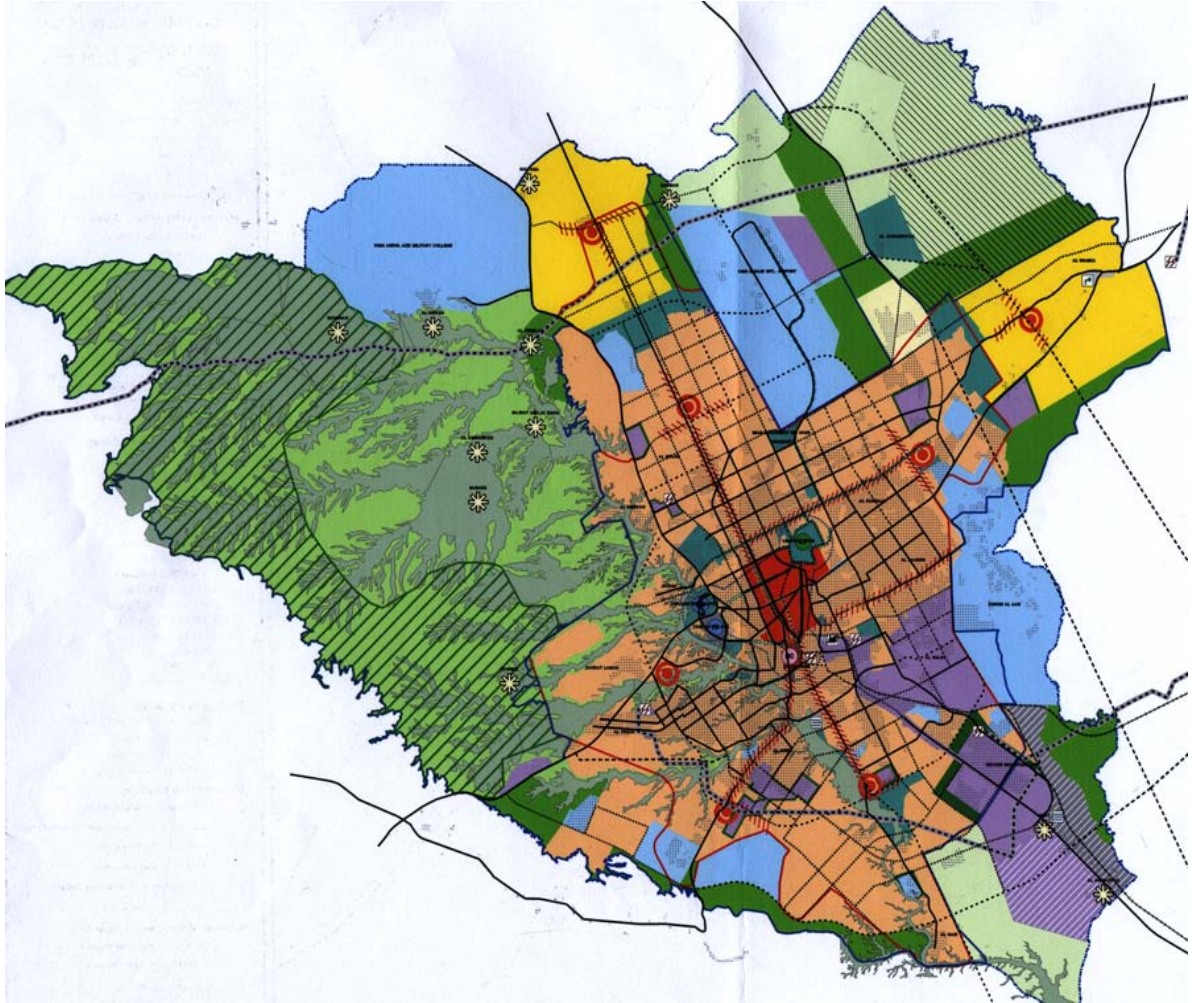


Figure 53 Area Extents of the Metropolitan and Regional Area of Riyadh 2021 MEDSTAR

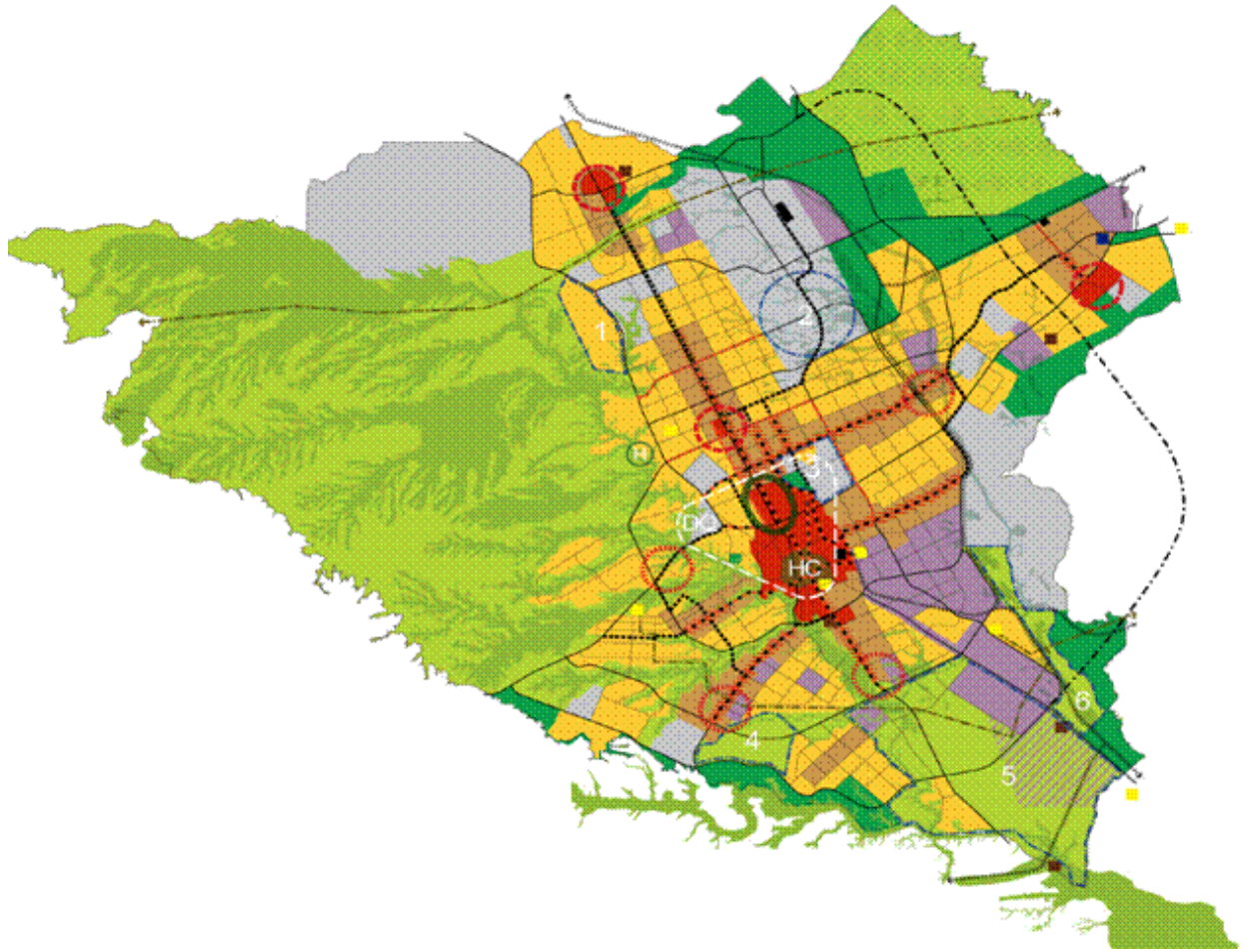


Figure 54 The Arrivadh Metropolitan Structure Plan 2030, MEDSTAR 2009

The existing urban area will be consolidated at higher densities. The historic city center will be evaluated for redevelopment to improve urban image and upgrade services and the existing building fabric. The area of urban land will be 2132 square kilometers excluding special uses such as airports. Non-urban land within the urban environment totals 2340 square kilometers and urban expansion is to occur within the Urban Limits Phase I and Phase II areas and will focus on five growth nodes distributed around and within the city in a radial pattern.



Figure 55 Photo Along Riyadh's Central Axis © MEDSTAR Review 2008

High density activity spines will link the metropolitan sub-centers to the central city area and new cities planned to the north and north-east peripheral edge of the city. These new activity spines are intended to be identifiable as traditional trading districts envisioned to enhance social interaction in a safe environment, and accommodate office, commercial, recreational and residential uses. Three types of activity spines are conceptually defined; the central spine, the primary activity spine, and the secondary activity spine. Parking continues to be a substantial problem in the main northern axis of the city, which was not adequately addressed by the Doxiadis land use plan. The task of engineering flows of traffic continues to be separated from the problems of parking cars in the city spine and surrounding commercial areas on the periphery of residential

districts. New strategies are needed to resolve these issues in tandem with the future planning of public transportation and green open spaces.

Residential communities are intended to strengthen the social fabric and internal cohesion of residential life. MEDSTAR plan states;

“...preferred approach to neighborhood planning and design should concentrate principally on a part of the present 'community size'. Instead of the present 2 km x 2 km grid providing the basic design unit neighborhood plans should be limited to a quarter of this area,- in effect forming four communities instead of one. In future with greater flexibility to break away from the grid as the basis for neighborhood design and develop Local Structure Plans more responsive to the environment and to social needs, it will be possible to avoid 'grid' development almost completely. In these circumstances the basic neighborhood size should, desirable, remain at about 3,000 – 4,000 people as described above.”

The Metropolitan Structure Plan, 1999, Section 4 – Community Development, p.113

Urban limits have been revised in the MEDSTAR 2030 plan with the majority of lands to be released for development are concentrated along the northern axial spine and to the south west of the city center. The two future cities are envisioned to be mega community projects which will inscribe new patterns of infrastructure and land use radically different from those previously defined by the Doxiadis master plan. New development and urban expansion to the west side of Wadi Hanifa will pose challenges for the installation of infrastructure services, requiring substantial infill due to the Wadi geography and topographical features.

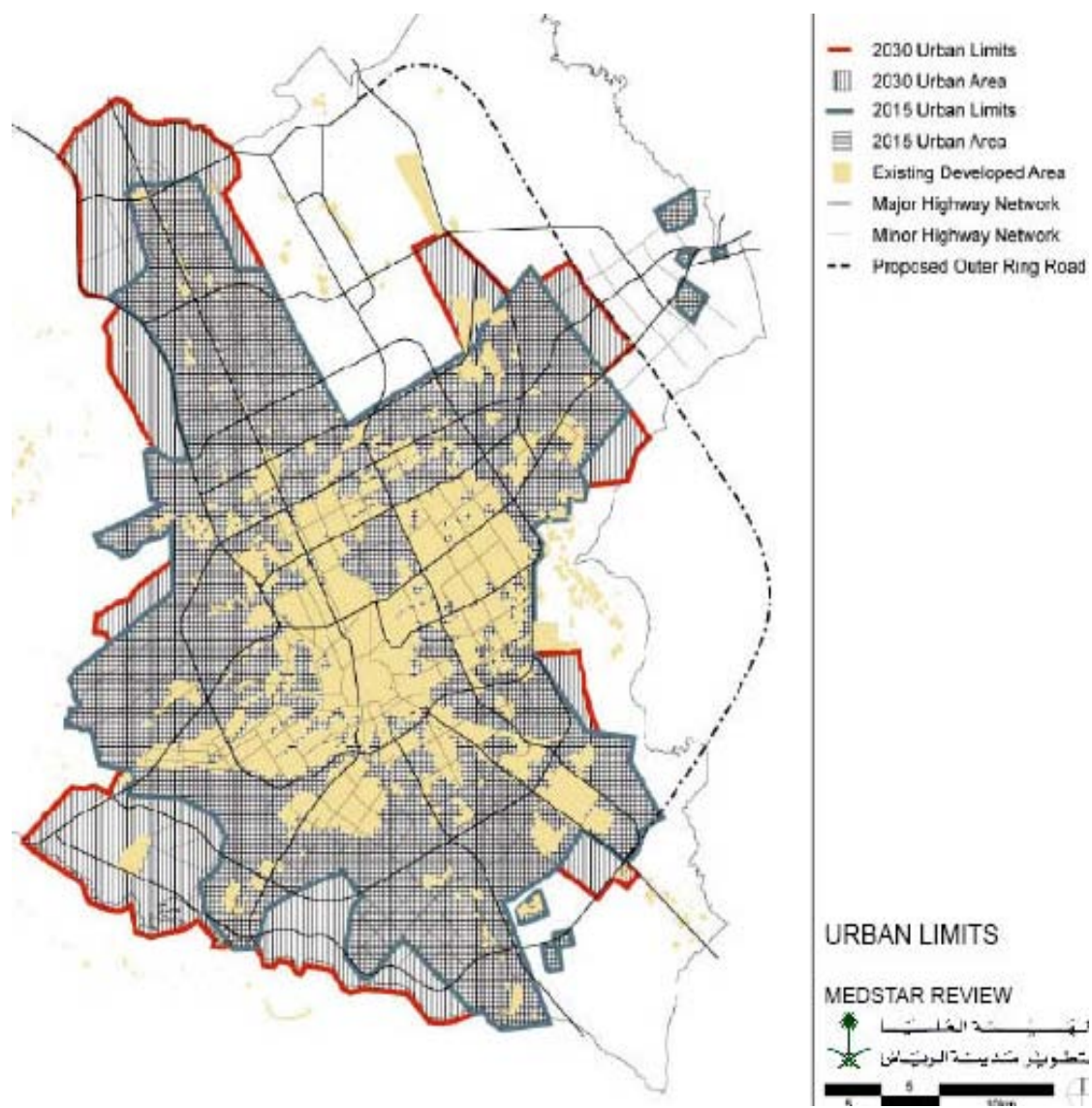


Figure 56 Proposed Revision to Riyadh Urban Limits

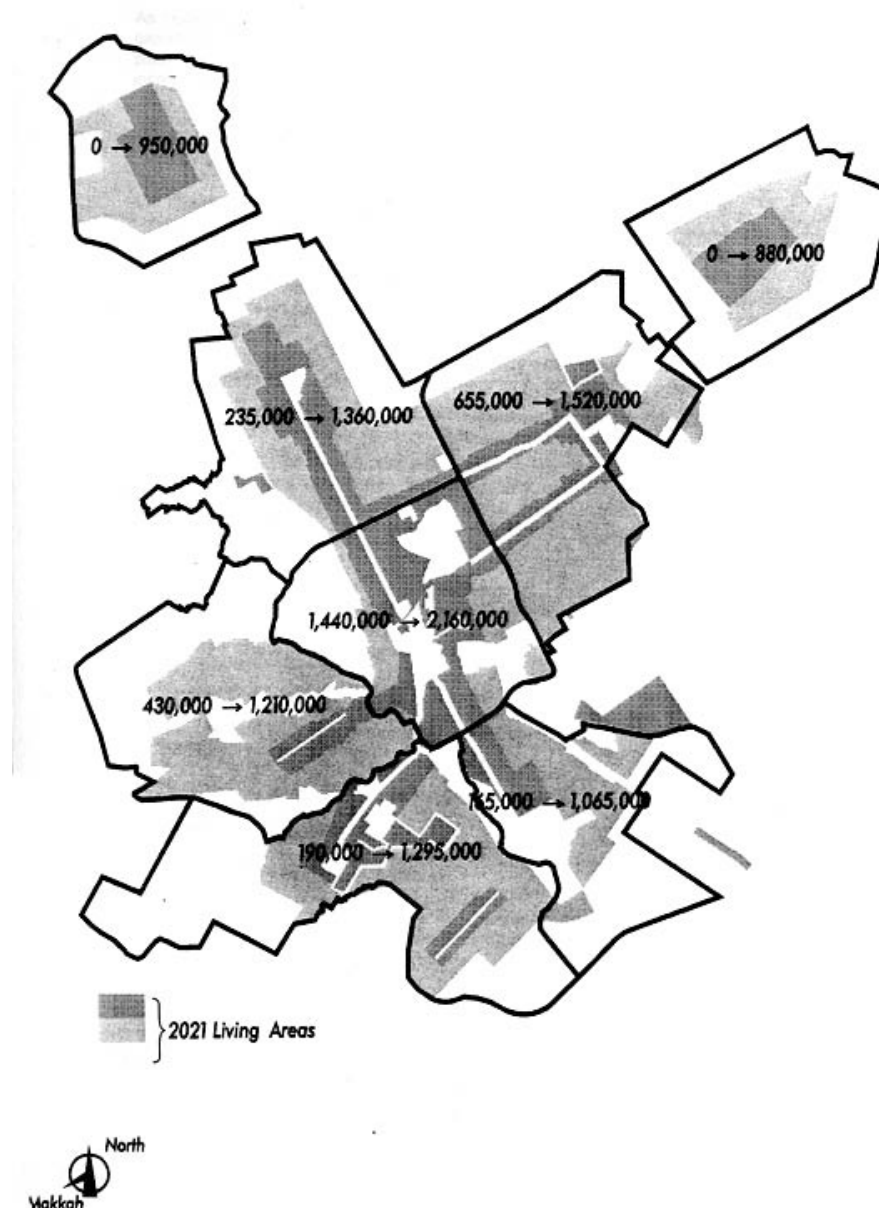


Figure 57 Strategic Population Distribution Planning 2021, MEDSTAR

‘The road network is an element which must serve the needs of the city rather than dictate its form and function. The future network will be a departure from current practice, which is to provide high speed limited access roads through the urban area. This approach is unsustainable as the environmental impacts of successive capacity upgrades destroy the urban environment....The new alternative road network is a system based on outer-urban ‘parkways’ that are designed to carry high-speed traffic longer distances with minimal impact on the city and the environment). One of the most significant features of the new plan is a new approach to managing water resources which will enable the ‘greening’ of the city, creating it as a true ‘urban oasis’ in the desert.’

MEDSTAR, Section 3 – Structure Plan, 1999, p.43

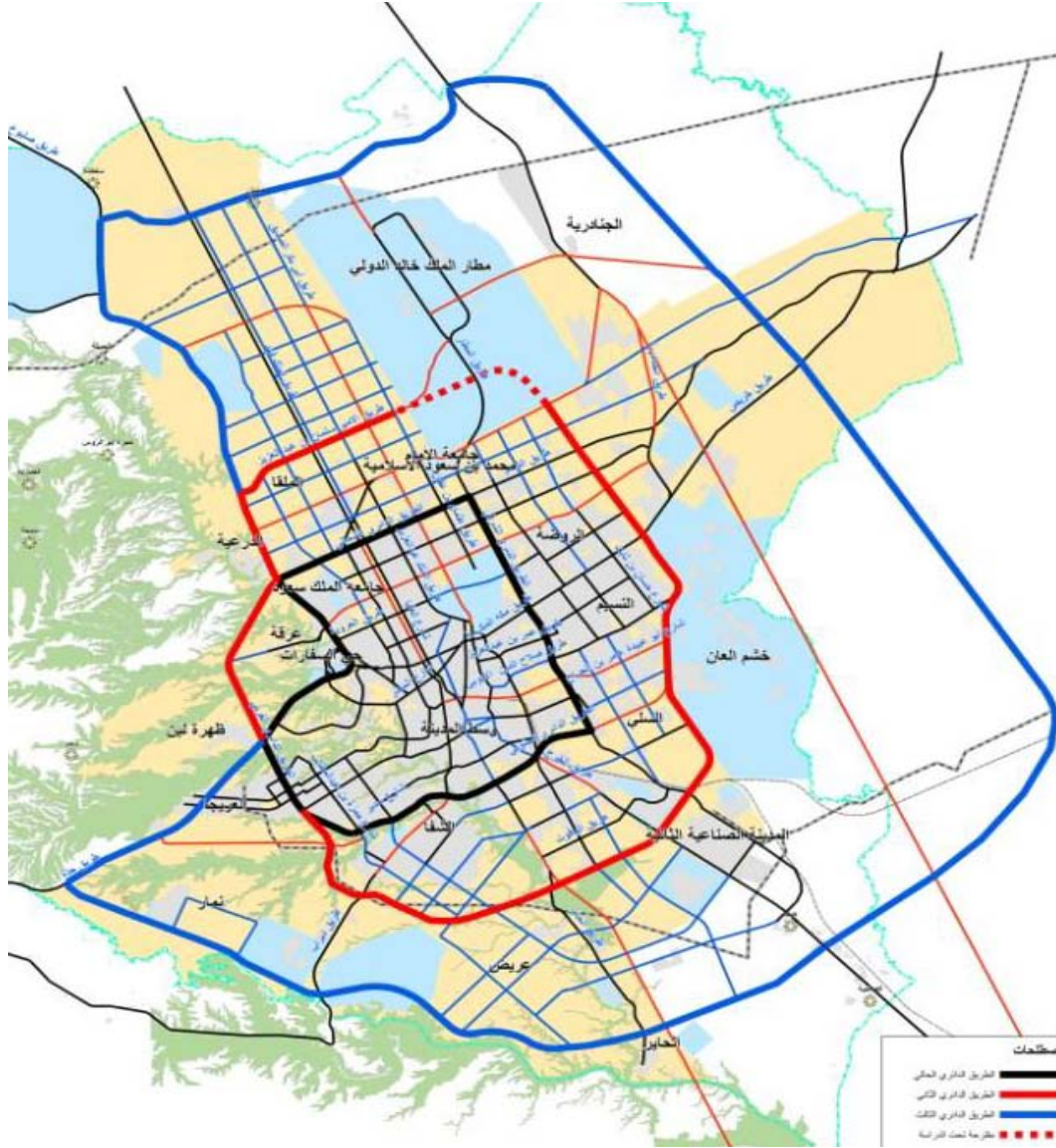


Figure 58 Proposed Road Network 2002 – 2022 © ADA 2009

5.6 Concepts of Urban Space and Modes of Urban Change

The MEDSTAR strategy institutes a major shift in how the spatial form of Riyadh is conceptualized, developed and governed. MEDSTAR offers a new spatial articulation for Riyadh, which infuses the strategy-making effort with project oriented development.

The MEDSTAR comprehensive development strategy in contrast to the Doxiadis Post-War master plan, conceptualize modes of urban spatial change, development and governance in different ways. MEDSTAR presents a model of urban governance where land use planning and implementation highlights aims to redefine socio-spatial processes to enable place making, ecological and environmental change. Importantly the MEDSTAR strategy also does not offer a connection strategy for future communities and urban center developments beyond the realization of the two satellite cities defined in the strategy. The young character of Saudi Arabian Society and Riyadh's population points to the continuation of a dynamic growth rate for the city beyond 2050. The trend of mega community developments by private developers will challenge the MEDSTARS organization of territory and supply of infrastructure services. These developments will like the new King Abdulla financial district currently designed according to a neo-traditional model, is under construction on the northern axis, will create a variety of urban spatial patterns and require new connection strategies and management approaches for infrastructure and other services.

Spatial comparison between the implemented Master Plan, Alternative 2 and MEDSTAR design strategies reveal significant shifts specific to the organization of territory and functions. In the Doxiadis strategies a compact urban form is aimed for with open spaces situated on the periphery of the city, as an attempt to contain and direct urban expansion. The MEDSTAR strategy in contrast utilizes open spaces to create a separation between the new planned cities to the north and east and the main city structure. Alternative 2 reflects the eastern commitments to land development and

establishes two east-west axes with secondary north-south axes intersecting near the center of the city.

Table 5 Comparative Matrix of Urban Design Strategies, 1972, 1978, 1996.


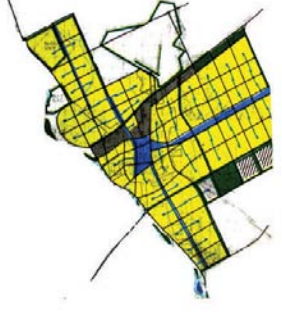
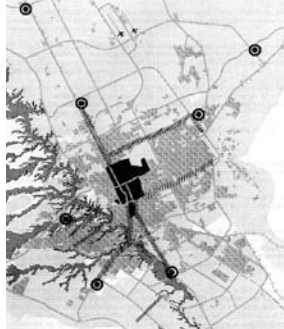
Urban Design Strategy	Doxiadis First Master Plan 1972 Alternative 4 (7)	Doxiadis Preliminary Master Plan Alternative 2	MEDSTAR 1996- 2021
Conceptual Model		 Alternative # 2	
Approach to Urban Structure	Single Axis Compact Uniform 2 km x 2km Block	Multiple Axis Emphasis is on Original Settlement Center Distributed	Centralization/Decentralization Multiple Axes & 5 Nodes Distributed and 2 New cities
Approach to Local Community Concept	Geometric Block and Spatial Hierarchy Strongly Bounded	Geometric Block	Cul –de-Sac structure; New Public Transport- Lightrail; New road development
Approach to Transportation	Oversized Highway Structures	Distributed and peripheral bounding of	Emphasis on Radial Expansion with New Axes
Approach to Urban Expansion & Growth	Uni-directional Aggregation of Moduli	Radial Aggregation Focusing on Three Axis	Dispersion of centers integrated by green open space
Design Emphasis	Legible Urban Form of the City	2km x 2km Block Deformation	Urban Identity and Social Integration
Approach to growth, connections and transitions	Aggregation of Blocks Direct Connection	Aggregation Bounded	Transition by Open Landscape Highway Bounded Urban Limits Contains Expansion
Limits to Expansion	Unlimited Expansion Limits Set by Natural Topography Expansion	Natural Limits of Wadi and Bounded by Highway	Set Urban Limits as distance from CENTRAL BUSINESS DISTRICT – Open limits

Table 6 Comparative Matrix of Urban Planning Approaches.

	Doxiadis Ekistics	MEDSTAR
Design Mode	International Modernist spatial structure	Mega projects reflect socio-spatial values
Governance Approach	Control of growth processes	Collaborative market driven processes
Attitude towards Change	Initial holistic structural transformation establishes process for future change	Partial - fragmented change driven by capital development
Conception of Time	Long Term	Short –medium term Demonstration oriented
Transformation Mode	Holistic continuity by	Variable Innovative- recursive - deconstructive
Development Mode	Linear expansion by aggregation of spatial units	Emergent & Recursive

The MEDSTAR spatial planning strategy continues to follow the organizational premise of Dynapolis, where multiple linear axes may develop and inspire new urban nodes to become established based on optimum travel distance between 4-6 kilometers from adjacent moduli to the activity spine.

The regional strategy for Riyadh outlined in MEDSTAR should be integrated more closely to the establishment of an urban form. The construction of a new third tier ring road conceived to provide a boundary to urban expansion, will with the release of new subdivisions instead reestablish a circular pattern to the city which will return the city to a more organic and piecemeal structure. Critically important to the success of this strategy will be the development of evaluation measures specific as to how the

MEDSTAR strategy will deploy projects, and integrate future planning strategies for the urban-region.

CHAPTER SUMMARY

Doxiadis conceptual spatial framework for the city is found to successfully accommodate rapid and dynamic urban expansion even as a radial development pattern occurred in opposition to the urban strategy of concentrating development along a single linear axis. Significantly the urban scheme has maintained its conceptual and spatial form and orders at the macro, local and transportation scales.

In practice the rapid development of multiple moduli districts, the continuing release of land to the market and real-estate speculation resulted in the spotty build-out of communities. The rapid rate of land subdivision at the modulus scale also resulted in an uneven realization of development and concentration population within moduli. A pattern of uneven growth and community class completion across all levels V, IV, III and II of community classes during the two decades after master plan implementation has been observed (al Buthie, MEDSTAR, 1999). The phasing of the master plan envisioned to occur as three stages resulted in the release of land within Moduli, each at a singular city scale with no apparent order of development. Al But'hie observes that within the King Faud Modulus the existing neighborhood plazas imbedded within Community Class IV act as nodes mostly during prayer times when people are going for prayers (Al-But'hie, 1986).

The initial uneven build-out of Moduli has also retarded the development of an internal synthesis of urban elements within the modulus district which would be

constituted by focal community-oriented architecture, landscapes, or public functions. Instead public spaces and functions began to be established on the peripheral edges of the modulus typically in the formation of shopping malls or conversions of warehouse and commercial space into indoor children playgrounds. In addition the rapid expansion of moduli has resulted in the oversupply of commercial and other land use designations which are located on the periphery of the modulus district. The result is the underdevelopment of community class centers and the spotty provision of community and commercial services across an extensive urban area (126).

The absence of a development strategy for the local scale of the modulus contributed to the inability to achieve a sustainable resident population density. MEDSTAR points to the continuing problem of the oversupply and distribution of commercial and other services spaces across the urban environs noting that peripheral development has dominated the spatial strategy and has resulted in poor service distribution to the interior of the moduli.

CHAPTER SIX

CONCLUSION

This thesis has evaluated how urban growth and change informed C. A. Doxiadis' development of urban design strategies within the first master plan for Riyadh. This study expands knowledge of his planning ideas and their specific translation into the master plan, a project undertaken nearly 10 years after Doxiadis' notable urban design project of Islamabad.

In the early 1950's the accelerating problem of urban expansion became linked to the increasingly heterogeneous context of the city, with concerns for growing slums and shantytowns fore-grounded in national and international debates. Post-War architects attempted to redefine modern city planning and design to address these concerns and resolve the perceived deficiencies of the functional city and C.I.A.M. principles. In Chapter Two, the review of urban approaches and projects by Kenzo Tange, Cornelius Van Eesteren, Alison and Peter Smithson, and the firms Candilis-Josic-Woods, and Bakema and Van den Broek reveal short term approaches to urban design that were project-oriented and unrelated to processes of urban growth and change.

Doxiadis' Ekistic Theory of Human Settlements forms a significant theoretical contribution to the history of Post-War urban design thought. Chapter Three illustrates how emphasis on urban growth and change infused Doxiadis' Ekistics theory and defined the urban design principles of Dynapolis. The model of Dynapolis was one element of Doxiadis' Ekistics theory which advanced urban design thinking to embrace a long term future and spatial resiliency. The conceptual model of Dynapolis established a rational strategy and methodology for the reorganization of a city's urban territory to structure the

dynamic processes of expansion and change. Dynapolis established a prescriptive approach to the design and development of a dynamic urban settlement that would expand in one direction and preserve circulation patterns, urban centers, and residential community districts. Doxiadis' spatial idea was to establish a rational spatial structure built on a hierarchical system of communities, transportation and infrastructures. The conceptual model of Dynapolis supported his comprehensive design strategies, which coordinated the organization of urban and regional territory, local community formation, the development of services and functions, and established a scaling of urban transportation and infrastructure. The spatial order of this model is based upon four central urban design propositions;

1. A single direction axis established clear orientation for urban structure to accommodate expansion. A dominant axis forms the central spine for the settlement with the possible formation of multiple axes with urban expansion.
2. The development of new centers, established on the central axis, distributes development concentrations and preserves the historical continuity of the settlement and its urban center.
3. The urban dimension of settlement expansion is the Modulus Unit (Sector) which is composed of a hierarchy of communities with associated circulation and infrastructure.
4. The transport structure established the spatial framework and defined the boundary edge of the modulus unit and internal community class structure. The pedestrian scale is limited to the interior of the modulus with clear separation from vehicular traffic.

In contrast to many Post-War architects, Doxaidis established a comprehensive vision of urban development which aimed to control processes of urban transformation and governance, through his elaboration of the Ekistics. The central argument of Ekistics theory was that a new conception of urban and regional life was needed to enable the

unhindered growth of the city. The spatial organization of territory was central to issues of urban governance and the control of the spatial form of development through time. For Doxiadis the universalizing homogeneity of the super grid and modulus district would be instrumental in reforming the increasing heterogeneity of modern life and manage social-spatial uncertainty and variability in the face of rapid change and spatial expansion. As the city expanded new urban centers would form, distributed along the structuring axis of the city to alleviate the historic center from pressures of development. The strategy of distributed centers was intended to redistribute traffic away from the historic core, and prevent the loss of urban land to support the unnecessary development of high volume – high speed roads.

Doxiadis' micro planning ideas were based on the ideal neighborhood unit scheme developed by Clarence Perry as part of the Garden City movement in the United States during the 1920's. The neighborhood unit idea emphasized the community as the new urban spatial element to define the growing city. Doxiadis expanded this spatial element into a comprehensive and integrated system building upon Walter Christaller's Theory of Central Places. The urban territory, therefore, was rationalized based upon the optimum ranges of human pedestrian movement and increasing scales of population density related to individual spatial units. The expansion of urban functions over time, within the spatial units, was resolved through a strategy of parametric scaling of units and functions, fulfilling Doxiadis' aim to develop a scientific approach to urban design.

The analysis of the Doxiadis' master plan for Riyadh is important as it reveals how Doxiadis reconfigured an existing settlement towards a modern metropolis based upon Eksitic ideals and Dynapolis principles. The master plan reorganized Riyadh's

urban territory and grafted a new super grid structure based on a universal 2 km x 2 km unit, referred to as the modulus. The modulus unit was inscribed by a modern transportation systems and infrastructure of water and sewerage, and telecommunications. The division of territory within the homogenous spatial unit – known as the modulus, allowed variations in design and subdivision for residential, commercial and civic needs. The settlement was structured to expand as a rational logical system where the deployment of urban infrastructure and land subdivisions would occur through a process of measured extension based on the aggregation of the Modulus unit. Infrastructure of roads, water and sewerage were designed to be extendable following the macro urban structure and modulus hierarchy.

In contrast to the majority of Post-War architects, who established the local circulation as the center of community life, Doxiadis advocated the layout of a spatial network of high-speed movement channels to create order for an expanding city. A second important distinction in the Doxiadis' design was the sensitive transitional design connection strategy, which united the existing irregular geometries and spatial dimensions of existing districts with a modern geometry. The Doxiadis plan reinforces the historic continuity of the existing settlement by establishing a progressive connection between the historic center and the new spatial framework of the 2 km x 2 km grid. Rather than ignore or destroy the historic city, a common approach in C.I.A.M and Post-War urban design circles, Doxiadis designed a graduated redefinition of urban form from the historic to the super-grid. This approach to sequential phasing of the urban spatial fabric was exceptional in urban design schemes during the Post-War period and is in

contrast to C.I.A.M.'s urban principles which aimed to remove a historical connection between the modern city and its past forms.

Significantly, Doxiadis' urban scheme, as proposed and implemented for Riyadh, has maintained the continuity of the strategies' original spatial form and structure at the macro, local and transportation scales. The spatial structure has sustained its stability due to the association of infrastructure services and the generously scaled transportation structure, which continues to accommodate increasing traffic flows across the city. The emphasis placed by Doxiadis on transportation and infrastructure services has enabled the rapid deployment of new territories for subdivision and development.

The Doxiadis spatial phasing of urban expansion was incomplete in defining a process and phasing of Ekistic community classes and associated commercial centers. Instead development phasing has focused primarily on the macro scale expansion of the city. Chapter Four identifies several problems that emerged due to the rapid aggregation and development of multiple moduli districts which resulted in the continuing release of land to the market, and ultimately fueling real-estate speculation. A pattern of uneven growth and community class completion across all levels V, IV, III and II at the local scale resulted as urban expansion unfolded and the master plan was implemented. The Riyadh phasing strategy also did not orchestrate associated commercial functions within the moduli.

The transportation hierarchy devised by Doxiadis also did not facilitate movement across the city or at the regional scale. The need for a ring road became obvious early on and was a key feature of the SCET update of the Doxiadis Master Plan in 1978. Subsequently the ring road came to define the organization of concentrated industrial and

mega commercial developments for Riyadh rather than the central axial spine. The MEDSTAR 2030 strategy establishes a new ring road to encircle the city which will in turn spur investments and future developments to form an important structure that redefines the development of the Riyadh region.

The continuation of the Doxiadis super grid and axially directed growth with the development of a second axis is a significant finding of the longitudinal study which has examined the spatial evolution of Riyadh's urban structure at the macro and local scales. Contemporary redevelopment of residential land to establish mega shopping complexes is resulting in a dramatic juxtaposition of spatial development scales and density within the local urban fabric. Over time this process will result in the fragmentation of spatial scales and the loss of the original planned modulus community class spatial hierarchy altogether will ultimately affect the ability of citizens to form social neighborhood communities, and identify with their local neighborhood through the legibility of the local spatial structure.

Doxiadis worked within a scientific rigorous planning methodology, which first assessed the surrounding context, spatial urban form and socio-spatial structure of the existing settlement. Predicting urban population growth rates posed a significant problem for this project. Doxiadis attributed the difference in population growth rate projections at the time to the sampling error in Saudi Arabian studies. Doxiadis's omission to examine the difference in growth rates and their consequences of each for the immediate years preceding the Riyadh master planning project was the single most critical error of the project.

Doxiadis was one of the most active urban design theorist and practicing urban designer architects of his time yet he did not focus on the architectural form of the city. His approach rather aimed to establish a dynamic and integrated system that would enable the city to adapt and be resilient to future technologies, changes, and variable rates of growth and enable governance control over growth processes. The rapid development of Riyadh after the adoption and implementation of the master plan has demonstrated the strength of Doxiadis' urban strategies. The master plan with its strong rational divisions of territory and structure of movement has established an intuitive spatial logic that informs current urban design decisions which are responding to the spatial context of the city. Doxiadis' design attempted to order society in a way to establish social stability through socio-spatial homogeneity based on a generalized conception of the city's future that was not informed by the culture or social organization of Saudi Arabian society.

Both SCET and MEDSTAR have developed as reactions against the universalizing forces of Doxiadis' urban design and its absence of constructing a vision of identity and capital image with both planning revisions aiming to develop a program that addresses the multi-functionality of the city, its ecological and economic environment through the demonstrable projects. Several challenges are emerging that place a renewed emphasis on understanding the underlying structure of the Doxiadis Master Plan. Future development concerns are focusing on policy evaluation and implementation, redevelopment of historic urban core area; mega projects and infrastructure connectivity, intensive redevelopment pressures within established neighborhood districts, open space planning and community development, connectivity affordances of urban spatial structures for future expansion, and the protection of

watersheds and regional area development. Riyadh's future development of two new satellite cities and the new ring road will redefine the city's spatial form with these new mega community developments. Attempts to limit urban expansion by the use of a boundary ring road will likewise result in significant lobbying for development rights adjacent to the new transportation infrastructure and lead to further expansion of the city. The current trend of mega residential projects and the two satellite cities identified for development will significantly break the development pattern of the city based upon the aggregation of Moduli. The new MEDSTAR strategy and the trend of mega community developments will challenge the management, connection coordination and continuing development of water and other infrastructure services across the city. The young character of Saudi Arabian society and Riyadh's population points to the continuation of a dynamic growth rate for the city beyond 2050 highlights the need for a dynamic growth and change strategy to be woven into the current outcome oriented MEDSTAR strategy. The MEDSTAR strategy importantly does not offer a long range connection strategy for future community developments.

Since the adoption and implementation of the master plan, Riyadh continued to advance its identity as a family oriented Islamic city exploring innovative urban design and ecologically oriented strategies. Significantly these plans have been guided by its Governor H. R. H Prince Salman bin Abd al-Aziz who has supported and witnessed the urban development of Riyadh for over four decades. Prince Salman's vision and dedication to Riyadh continues to inspire and influence the city's development and influence cities across the Kingdom through organizations such as the Prince Salman

Center for Local Governance, the High Commission for the Development of Arriyadh and the Arriyadh Development Authority amongst others.

During the Post-War period, spatial planning emerged as the central component in shaping and delivering places. Research into Post-War architecture and urban design has only recently begun to investigate the wealth of ideas and design projects that emerged as architects and urban planners began to question the modern design project for the city. This thesis has examined how urban design strategies are implemented over time to further our understanding of growth processes and the phasing of urban development. The study of the underlying ideas and strategies applied in the many projects implemented during this period is critical to understand the rational logic of the urban form and discover potential design solutions that may be activated and realized in contemporary urban design. The case of Riyadh highlights the need for more study of the extensive urban design projects of Doxiadis, which will inform our understanding of how urban expansion tendencies evolve over time specific to spatial structure and its development. Doxiadis Ekistics approach highlighted the need for the rational thinking about space and place as a basis for action or intervention. Doxiadis' Ekistics strategy established a spatial planning framework that was layered, integrated, and dynamic, all qualities highlighted in contemporary comprehensive spatial planning approaches. His strategy was outcome-focused but also programme-based with an orientation towards the long term future. Its shortcomings were in the articulation of place making strategies and project specific delivery processes.

APPENDIX A

BREAKDOWN OF LAND USE IN THE PROPOSED RIYADH

MASTER PLAN 1972

Master Plan Area Requirement by 2000
(Table 34 Master Plan Report)

Item	Part Areas in ha	Total area in Sq. Km.
1. Residential Sectors		
a. Housing plots	9,636	
b. Schools	1,090	
c. Health facilities inside Residential communities	81	
d. Mosques inside residential Communities	160	
e. Local centers	150	
f. Parks and open spaces	490	
f. Local streets	4,818	164.05
2. Central and Major Functions		
a. Central commercial areas	426	
b. Administrative areas	590	
c. Royal establishments	200	
d. Health facilities Centrally located	182	
e. Industrial areas	1,416	
f. Green and major open spaces (national parks, zoo, national athletic centre, etc.)	700	
g. Cemeteries	280	
h. Major roads	4,818	
i. University and higher e Education buildings	900	96.12
Total		260.17

Breakdown of Land Uses of the Proposed Riyadh Master Plan-Relocating Airport.

Land Uses	Area in sq. km	Percentage	
Residential Class V	<u>172.03</u>	<u>78.11</u>	<u>56.52</u>
Central Functions	<u>12.80</u>	<u>5.81</u>	<u>4.20</u>
a. commercial, business and civic	7.28		
b. administration	3.12		
c. cultural	2.40		
Royal Establishments	0.44	0.20	0.14
Institutions and Green Areas	5.75	2.61	1.89
Existing Cemeteries	0.40	0.18	0.13
Existing Sewage treatment Plant	0.19	0.09	0.06
Major Road systems	28.61	13.00	9.40
Total City Proper Area	220.22	100%	
Manufacturing	9.55	3.14	
Railways	1.76	0.58	
National University	14.43	4.74	
Special Use Zone	47.51	15.63	
a. Special use buildings	35.33		
b. Industry	6.09		
c. National athletic centre	1.96		
Green Areas	1.20		
Major road system	2.93		
Regional Parks sports grounds	10.89	3.57	
Grand Total	304.35	100% Cumulative Area	

Needs for Residential Communities

Item	Standards	Years			
		1970	1975	1980	2000
1. Base Data					
a. Population	-	355,000	525,000	685,000	1,400,000
b. Local Resid.	-	3,770	5,485	7,240	15,050
2. Area Needs (ha)					
a. Net residential Plots	246-336 sq.m.	1,775	2,609	3,418	9,636
b. Schools	0.55 & 1.50 ha	96	215	373	1,070
c. Health Facilitates	-	16	26	37	81
d. Mosques	-	58	79	92	160
e. Local Centers	100 empl./ha	38	55	72	150
f. Parks & open spaces	3.5 sq.m/inh.	124	184	240	490
g. Local streets	50% of res.pl.	888	1,305	1,709	4,818
Total Area Needs	2,995	4,473	5,941	16,406	

APPENDIX B

COMMUNITY CLASS STRUCTURE & ROAD HIERARCHY

AND

1972 MASTER PLAN TRANSPORTATION STRUCTURAL

HIERARCHY FOR RIYADH

Hierarchy of Communities for Riyadh Kingdom of Saudi Arabia, 1972

Order of Community	Population Size	Functions									
		Education	Commerce	Business	Services	Health	Transport	Socio-Cultural	Recreation	Industrial	Administrative
Class I	40								Small Square		
Class II	250	Kindergarten/ Primary school	Corner Kiosk						Play Area for Pre-school age		
Class III	1,500	Kindergarten/ Primary /secondary school	Small Local market		Barber		Bus-stop Post Office	Small Mosque	Play Area for pre-school age children		
Class IV (Neighborhood or Small city)	9,000	Secondary school	Small shopping center	Real Estate Office	Gasoline Station Plumber, electrician. Photographer	Dispensary Doctor's Office	Taxi station Small Post-Office Telegraph Office	Mosque, Local Club	Small Public garden square	Handicrafts	Police Station for every 4-5 communities
Class V (City)	50,000	Secondary/Trade Commercial school	Central Market	Bank Insurance Offices	Lawyers Doctors Engineers	Health Center, Private Clinics	Local inter-urban Bus Railway Airport Central Post-office	Large Mosque, Meeting Hall, Library	Playing Fields, Small Parks	Light Industries, Intermediate Industries	Local Police, Division Municipality Offices
Class VI (Large City)	300,000	Small University	Commercial Center	Large Bank, Headquarters business firms Large representative offices	Professional Organizations Large local offices	General Hospital	Large Local and inter-urban Bus Station	Central Mosque, Museum, Art galleries, Small Concert Hall	Stadia, Parks, Theatres	Intermediate and Heavy Industry	Government Headquarters
Class VII (Metropolis)	2,000,000	Large University	Large Commercial Center Wholesale center/ warehousing	Central Offices Banks, Insurance, Headquarters large firms	Headquarters of large private offices	Large General Hospital Specialized Hospital	Central Rail, Bus Stations, Large Airport	National Museums, Permanent Art Galleries, Exhibition Halls	Olympic Stadium, Race course Large Parks	Heavy Industry, Special Industries.	Seat of National Government

(Dox-SAU- A19 pg. 263 Table 47)

Riyadh Saudi Arabia Typical Cross-Sections of Roads Summary

Roadway Classification (single direction)	Number of Traffic Lanes	Future Expansion	Total Cross-Section Width	Suggested Pavement Width	Suggested Median Width	Suggested Parking	Green Space	Pedestrian Sidewalk Width
Freeway	Service road, emerg. lane, 3 lanes	2 lanes	84.0 M 275.6 Ft	Service 6.5 Emerg. 3.0 Main 10.5	5.5 M 18.04 incl. expansion	Parallel parking	8.0 M 26.25	6.0 M 19.7 ft
Expressway	6 lanes & service road	2 lanes	80.0 M 262.5 Ft	Service 6.5 Emerg. 3.0 Main 10.5	5.5 M 18.04 incl. expansion	Parallel parking	5.0 M 16.4	7.0 M 22.9 ft
Expressway	6 lanes no service road	Yes	60.0-80.0 M 196.85-262.5 Ft	Emerg. 3.0 Main 10.5	2.5 M 8.2Ft	No	14-24 M 45.9-78.7 incl. sidewalks green service roads future expansion	incl. sidewalks green service roads future expansion
Arterial	(4-6 lanes)	2 lanes	60.0 M 196.850 Ft	Emerg. 3.0 Main 7.0-10.5	5.5 M. 18.04 Ft	No		11.0-14.5M 36.1-47.6 ft
Arterial	(6 lanes)	no	36.0-40.0 M 118.11-131.2 Ft	Main 10.5	2.0 M. 6.56 Ft	No		5.5 -7.5M 8.2-24.6 ft
Arterial	(4 lanes)	2 lanes	.36.0-40.0 M 118.11-131.2 Ft	Main 7.0	5.5 M 18.04Ft	No		5.5 -7.5 M 8.2-24.6 ft
Major Collector Road		Yes	20.0 M 65.6 Ft.	Main 7.0	-	2.5 M 8.2 Road Parking	5.5 M 18.04 incl. sidewalk	2.5 M. 8.2 ft
Collector Road		No	12.0-14.0- 16.0 M 39.4-45.9-52.5 Ft	Main 3.5-4.5	-	No		1.5/2.5/3.5 M 4.9-8.2-11.4 ft
Local Road		No	8.0-10.0 M 26.25 -32.81Ft	Main 3.0-3.5	-	No		1.0-1.5 M 3.28-4.9 ft
Major Pedestr. Street	-		14.0-16.0 M 45.9-52.5 Ft	-	-	No	3.0/8.5-10.0 9.8-27.88-32.8 incl. sidewalk	2.5 M 8.20 ft
Pedestr. Street	-		8.0-10.0 M 26.24-32.80 Ft	-	-	No		1.0-1.5-2.0 M 3.28-4.9-6.6 ft

* This table summarizes the Typical Cross-Section of Roads D-SAU-A30010/333 First Master Plan Arriyadh 1972. All figures have been converted to imperial for comparison

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